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CHEMICAL & ENGINEERING NEWS

C&EN

AUGUST 22, 1994

CHEMICAL COMPANIES FIGHT ENVIRONMENTAL SELF-INCRIMINATION PAGE 13

Facts & Figures for CHEMICAL R&D

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CHEMICAL & ENGINEERING NEWS

C&EN

AUGUST 22, 1994

NEWS OF THE WEEK

- Crystal structure studies of a hydrolytic catalytic antibody reveal that the antibody's active site has structural similarities with serine proteases—an important class of enzymes. **Page 6**
- American Home Products and American Cyanamid end two weeks of suspense by agreeing on a friendly merger, with AHP paying $9.7 billion, or $101 a share, for Cyanamid. **Page 7**
- German police have seized nuclear materials containing weapons-grade plutonium that may have been smuggled from Russia or other former Soviet republics. **Page 7**
- U.S.-North Korean pact takes a major step toward allaying concern about North Korea's suspected nuclear arms program, but serious questions remain. **Page 8**
- A National Assessment of Educational Progress trend report finds substantial gains in precollege science and math proficiency. **Page 8**
- German chemicals giant Hoechst announces that its researchers have developed a plastic that removes ozone from air and water, with potential wide uses in air filtration. **Page 9**

COVER: Research chemist at Lubrizol prepares sample for gas chromatography

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BUSINESS

Self-incrimination remains a barrier for industries to conduct self-audits, despite the benefits of increasing regulatory compliance and reducing environmental risk. **Page 13**

GOVERNMENT

Congress tackles environmental issues, including the Superfund reauthorization bill and reform of pesticide and food safety laws that would repeal the Delaney clause. **Page 18**

General Accounting Office concludes that the GATT trade pact is good for the U.S.; critics worry that some of its provisions may have power to alter U.S. laws. **Page 20**

SCIENCE/TECHNOLOGY

A theoretical study predicts AIDS virus may have up to four unexpected new genes and that selenium may play an important role in delaying onset of symptoms in infected individuals. **Page 23**

New evidence favors the controversial hypothesis that scrapie and related neurological diseases are caused by infective proteins rather than by viruses or other infectious agents. **Page 25**

EDUCATION

A student at Purdue is awarded simultaneous Ph.D. degrees in chemistry and physics for the first time in the U.S. **Page 32**

BOOKS

"Profits of Science: The American Marriage of Business and Technology" describes how high technology has spawned both the success and failure of business in the U.S. since the 1930s. **Page 72**

ACS NEWS

UCLA's Joan S. Valentine has been appointed editor of the ACS journal *Accounts of Chemical Research.* **Page 75**

AWARDS

Winners of the 1995 American Chemical Society national awards have been selected. **Page 77**

CHEMICAL R&D

C&EN's annual look at chemical R&D statistics finds the overall U.S. R&D effort up only a very modest 1% this year; chemically related R&D, however, is growing somewhat faster. Page 34

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LETTERS

What kind of science policy?

In implementing the campaign mantra "It's the economy, stupid!" President Clinton stated that "technology is the engine of economic growth," and he has undertaken policies to ensure the competitive advantage to U.S. industry for winning the new "economy war." Policymakers' emphasis on the utilitarian aspects of science has resulted in great apprehension within the "basic" research community, fearing that the shift undermines the wonderful symbiosis of the past 50 years between government and the science community.

Indeed it was a wonderful symbiosis—articulated in 1945 by the visionary Vannevar Bush report "Science—The Endless Frontier"—nurtured by the needs of national security and credited with contributing mightily to winning the Cold War and increasing the wealth of the nation while affording scientists the opportunity to pursue their interests in an almost unencumbered manner.

That era, however, is over. The collapse of the Soviet Union, mounting budget deficits, and demands on public funds require a new vision for science. Sustainable development, repair and maintenance of the planet, and continuous improvements in human well-being, inter alia, present an "endless frontier" of challenges for, and contributions from, the entire science community.

The natural disquietude from the search for a new rationale for funding science has been complicated by developments in the science community itself: many new Ph.D.s from U.S. universities, immigration, and restructuring of industrial R&D; the explosive growth of costs, especially in "big" science; and a few highly publicized cases of fiscal abuse or scientific misconduct.

A rather healthy dialogue is under way between the two communities, including a number of reviews, such as the Galvin Commission review for Secretary of Energy Hazel O'Leary regarding the future of the national laboratories. This thorough reexamination of the issues involved bodes well for defining the needed new vision. However, there are attitudes that are not helpful—for example, comments from some leaders of the science community that, instead of helping articulate a new vision, question the public's support of or ability to understand the issues involved and challenge the privilege of the public and its representatives to set priorities and demand accountability. There is a touch of hubris in this attitude, against which the great physicist Erwin Schrödinger warned when he wrote: "All science is bound up with human culture, in general, and ... scientific findings, even ... the most advanced and esoteric and difficult to grasp, are meaningless outside their cultural context. ... A theoretical science ... where the initiated continue musing to each other in terms that are, at best, understood by a small group of close fellow travelers, will necessarily be cut off from the rest of cultural mankind; in the long run, [this kind of science] is bound to atrophy and ossify however virulently esoteric chat may continue within its joyfully isolated groups of experts."

Although there is no basis for entitlement, continued leadership in basic science is critical. Attempts to undermine the magnificent edifice of U.S. science must be resisted, for strong basic science may not guarantee technological breakthroughs, but it certainly makes them more likely. Therefore, the debate needs to focus on setting national goals and priorities, and on how to best canalize the finite resources to achieve these national goals.

The so-called Apollonian science—goal oriented and milestone checked—has been the dominant approach even during the great symbiosis of the government and the science community, when the mantra was "national security." The approach is particularly appropriate in an era of limited resources, provided that Dionysian science—opportunities for serendipitous discovery and unprogrammed breakthroughs—is not stifled, and that the tyranny of micromanagement and the promise or requirement of unrealistic expectations can be avoided. Finally, the deconstructing of industrial R&D must also be reexamined.

Corrections

- This issue, page 46: In the top headline, total industrial R&D spending, not chemical industry R&D spending, rose 4% in 1993 to $126 billion; chemical industry R&D spending rose 10% to $18.4 billion.
- Aug. 8, page 8: American Home Products owns a majority stake in Genetics Institute, not Immunex. American Cyanamid is the majority owner of Immunex.

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Facts & Figures FOR CHEMICAL R&D

Mairin B. Brennan and
Janice R. Long,
C&EN Washington

Total R&D spending in the U.S. seems to be growing very slowly this year. C&EN estimates that overall support for R&D will rise only 1% in 1994. R&D performed by the chemical industry, however, like that performed at universities and colleges in the disciplines of chemistry and chemical engineering, is growing faster.

But that bottom line is only a small part of the information contained in C&EN's annual report Facts & Figures for Chemical R&D. The following 26 pages of text, tables, and graphs measure the pulse and many other vital signs of the enterprise closest to the hearts of many chemical professionals. This special report details not only where R&D funds are coming from and where they are spent but also the changing demographics of the new graduates entering the profession and how the overall U.S. R&D effort stacks up against those of some of the country's major foreign competitors.

According to estimates from the National Science Foundation, U.S. industry as a whole will spend $101 billion to support industry-conducted R&D this year—only 2% more than it did last year. NSF predicts that federal support for R&D will be $71 billion, unchanged from last year's levels. Together, these two sources have, in recent years, accounted for about 94% of total R&D spending, with the rest coming from universities, other nonprofit institutions, and industrial support for R&D conducted at universities. Although estimates of 1994 spending from these other sources are not yet available from NSF, C&EN estimates that total R&D spending this year will be about $183 billion. That's up a very modest 1% from 1993.

The federal government's curb on the growth of its share of R&D funding in 1994 follows an estimated 9% gain in 1993. This year, funding for the Department of Defense—the federal department with the largest R&D budget—is expected to drop 4% to $37.5 billion, or 53% of federal R&D funds. DOD's share of these funds has been shrinking since the late 1980s, when it was as high as 64%. DOD funding is heavily weighted toward the development side of R&D, with 88% of this

1 FEDERAL GOVERNMENT

Spending on R&D, particularly in chemistry and chemical engineering, by the federal government and by various federal agencies. **Page 39**

2 INDUSTRY

R&D spending by industry, especially by companies within the chemical industry. Where industrial chemists work and how much they are paid. **Page 46**

3 PATENTS & LITERATURE

U.S. chemical patents issued and their countries of origin. Fields in which chemical papers are published, countries where they originate. **Page 52**

4 UNIVERSITIES & COLLEGES

Where academic institutions get funds for R&D and which schools spend the most. Chemical degrees awarded. Foreign graduate students. **Page 58**

Merck & Co. photo

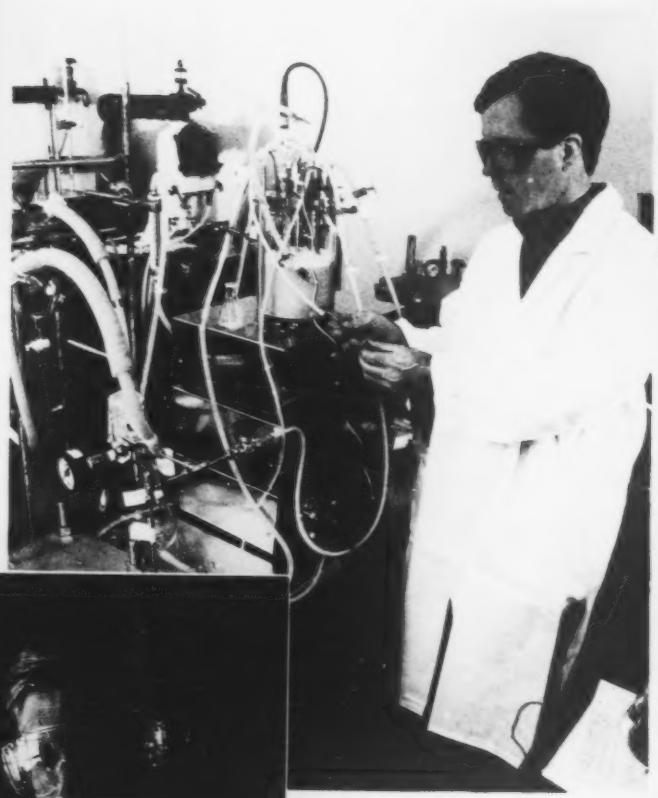


Photo by Peggy Greb, courtesy of USDA

Photo by H. Mark Weidman, courtesy of Rohm and Haas

year's R&D support to be spent on development.

Other than DOD, the biggest federal supporter of research is the Department of Health & Human Services, which does so primarily through its biomedical research arm, the National Institutes of Health. HHS's R&D budget will grow 4% to $10.7 billion in 1994, NSF estimates. Nearly 60% of that, or $6.1 billion, will support basic research.

Another major source of federal research funding—the National Science Foundation—has also come out on the plus side in this year's zero-sum game of federal R&D support. NSF estimates that its own overall R&D spending will rise 7% in 1994 to $2.22 billion, a bigger gain than the agency's 6% annual growth rate since 1987.

For a few agencies, in fact, 1994 will be a windfall year for R&D funds. As might be expected, the Clinton Administration's emphasis on environmental technologies and competitiveness is reflected in large increases in funding for R&D at the Environmental Protection Agency and the Commerce Department. EPA funds are expected to increase 26% to $656 million in 1994, following an 8% rise in 1993. Commerce is slated to receive an estimated $869 million in R&D funding, or 22% more than in 1993, when the agency's funding was boosted 13% from the year before.

Just over 40% of Commerce's R&D funds in 1994 are being allotted to the National Institute of Standards & Technology (NIST). Among other functions, NIST administers the Clinton Administration's Advanced Technology Program, which provides cost-shared grants to industry for development of high-risk technologies with significant commercial potential. NIST R&D funding will be up 46% this year to an estimated $382 million. Despite the big jump in funds, however, EPA and Commerce account for only 2% of federal R&D funds in 1994.

Federal funding for research in chemistry, which had been growing 6% annually since 1987, is expected to rise only 3% in 1994 to $1.05 billion. Funding for research in chemical engineering follows the same pattern: Compared with an annual growth rate of 8% since 1987, federal support this year will increase just 3% to $364 million. Still, with overall federal R&D monies frozen this year, any increase has to be counted as good news. By contrast, federal funds for physics research are expected to drop 4% to $2.70 billion, probably reflecting the demise of the Superconducting Super Collider.

Federal funding for university research in chemistry will also be up this year, growing 5% to an estimated $431 million, with NSF and NIH providing 69% of the funds. Although both agencies are contributing more than they did in 1993, the rise in support lags the annual growth rate since 1987. DOD, on the other hand, which has either cut or flattened its funding in just about all areas of R&D this year, is increasing funding for university research in chem-

istry by 16% to an estimated $62.3 million, or 14% of all federal support for such research.

Although overall industrial R&D spending will be up only modestly this year, it grew an estimated 4% both last year and in 1992, according to NSF data. Comparisons with earlier years are harder to make, however. That's because NSF's most recent industry-wide survey, conducted in 1992, sampled 23,000 firms, up from 14,000 the agency surveyed previously. For the year in which the two surveys overlap, the new one shows considerably more industrial R&D spending than the old one did. Total industrial R&D spending in 1991, for example, jumped from $102 billion in the old survey to $117 billion in the new one, a difference of 15%. The agency has not revised data prior to 1991 to reflect this change.

Spending within the chemical industry will likely rise faster this year than for industry overall. Data for 1993 certainly show that R&D budgets at drug firms, in particular, were growing rapidly. On the basis of NSF data, C&EN estimates that R&D funding at companies throughout the chemicals and allied products industry increased 10% in 1993 to $18.4 billion, boosted by a 17% increase at drug firms. Drug firms last year performed 56% of the R&D of this industry group ($10.3 billion), up from 41% ($3.66 billion) in 1986.

Drug companies employed 42,600 scientists and engineers in 1993, 10% more than in 1992. By comparison, industrial chemical companies employed only 29,600, down 1% from the year before, and other chemical firms employed 17,000, the same as in 1992. Drug companies also far outstripped other chemical firms in the average number of scientists and engineers (108) per 1,000 employees in 1992. That year, on average, industrial chemical firms employed 66, and other chemical firms 53, scientists and engineers per 1,000 employees.

Universities and colleges increased their R&D effort in science and engineering by a healthy 7% to $18.9 billion in 1992, the latest year for which data are available. However, that's less than the annual 10% growth universities had been averaging for the decade.

The federal government, the largest source of academic R&D funds, hiked its funding by 8% to $11.1 billion in 1992. That's a little less than the 9% annual gains these funds have been averaging since 1982. University funding for its own R&D grew 5% to $3.58 billion, far below the 12% annual increase for the decade as a whole. Industry, too, restrained its contribution ($1.30 billion) to an increase of 8% over 1991, down from 14% annually since 1982. In 1992, federal funds accounted for 59% of academic R&D spending; university funds, 19%; and industrial support, 7%.

Universities reined in chemistry's share of R&D spending in 1992 more than any other field of science or engineering except computer science. Chemical R&D spending at universities increased only 4% to $701 million, following a 9% annual increase for the decade. (R&D spending for computer science remained at the same level as the year before, after rising 17% annually since 1982.) In tune with the overall tightening of academic R&D spending, chemical engineering's share rose 7% in 1992 (to $262 million), after a 13% annual rise for the decade.

Despite spending 3% less in 1992, the University of Texas, Austin, outranked all other schools in money spent on chemical R&D ($16 million) that year, as it had in 1991, according to data collected from the schools by NSF. Harvard University, which boosted spending 14% in 1992 to $14.1 million, moved into second place from fifth in 1991. Massachusetts Institute of Technology, which spent $14 million on chemical R&D funding in 1992, 15% less than the year before, dropped to third place, down a notch from 1991. Federal funds accounted for just over half of the University of Texas' chemical R&D support, 88% of Harvard's, and 89% of MIT's in 1992.

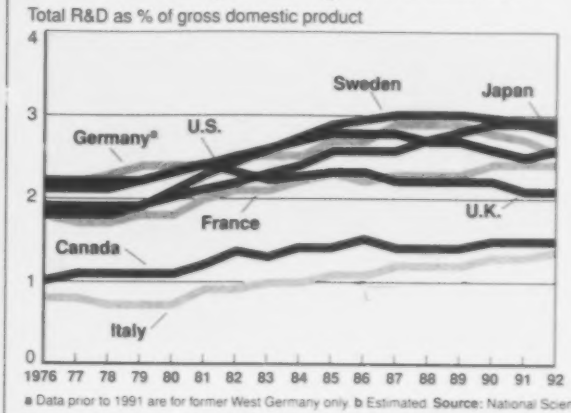
MIT led all other schools in spending on chemical engineering R&D in 1992, at $13.0 million, although it spent 23% less than in 1991, when it also ranked first. Texas A&M University moved into second place, spending $12.4 mil-

TOTAL AND NONDEFENSE R&D: U.S. reverses 1991 cut in total and nondefense spending

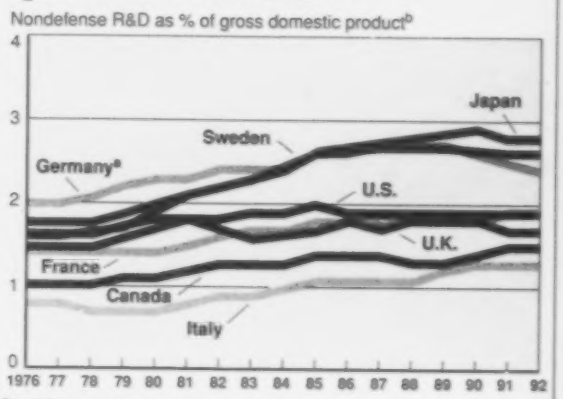
$ Billions, constant 1987	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[a]	% annual change 1991–92	% annual change 1982–92
TOTAL R&D													
U.S.	$95.5	$102.3	$111.1	$120.6	$123.3	$125.4	$128.7	$129.7	$129.3	$123.5	$127.6	3%	3%
Japan	30.9	33.5	36.0	40.0	40.6	43.4	46.9	51.3	55.5	57.2	56.5	–1	6
Germany[b]	21.1	21.4	21.8	24.0	24.5	26.1	27.0	28.0	28.2	30.3	30.0	–1	4
France	15.0	15.5	16.4	17.0	17.2	17.9	18.7	19.8	21.0	21.3	20.8	–2	3
U.K.	na	14.4	na	15.6	16.5	16.8	17.0	17.6	17.7	16.1	16.5	2	2[c]
Italy	6.0	6.4	7.0	7.9	8.2	8.9	9.4	9.9	10.6	11.0	11.6	5	7
Canada	4.7	4.8	5.2	5.6	5.9	6.0	6.1	6.1	6.5	6.7	6.7	0	4
Sweden	na	2.8	na	3.3	na	3.6	na	3.8	na	3.5	na	na	na
NONDEFENSE R&D[d]													
U.S.	$69.2	$ 73.6	$ 79.0	$ 84.9	$ 85.2	$ 86.2	$ 90.1	$ 92.3	$ 94.0	$ 90.1	$ 94.5	5%	3%
Japan	30.7	33.3	35.7	39.7	40.3	43.1	46.5	50.9	55.0	56.7	56.0	–1	6
Germany[b]	20.2	20.4	20.8	22.7	23.3	24.9	25.7	26.7	26.7	29.0	28.7	–1	4
France	11.6	12.2	12.9	13.4	13.5	14.0	14.5	15.5	16.1	16.9	16.9	0	4
U.K.	na	10.6	na	11.5	12.6	13.2	13.9	14.5	14.7	13.1	13.3	2	3[b]
Italy	5.8	6.2	6.6	7.5	7.8	8.5	8.8	9.3	10.2	10.5	11.0	5	7
Canada	4.6	4.7	5.0	5.5	5.8	5.8	5.9	5.9	6.3	6.5	6.6	2	4
Sweden	na	2.5	na	3.0	na	3.2	na	3.4	na	3.1	na	na	na

a Preliminary. b Data prior to 1991 are for the former West Germany only. c 1983–92. d Estimated. na = not available.
Sources: National Science Foundation and Organization for Economic Cooperation & Development

Sweden leads other nations in share of gross domestic product spent on R&D . . .



. . . and Japan is frontrunner in share spent on nondefense R&D



a Data prior to 1991 are for former West Germany only. b Estimated. **Source:** National Science Foundation

lion, or 24% more than it spent in 1991, when it held third place. Federal funds accounted for 64% of MIT's support in chemical engineering R&D in 1992 but only 16% of Texas A&M's.

A few more people received doctorate degrees in chemistry in 1992 than in 1991, according to data from both the National Center for Education Statistics (NCES) and NSF. According to NCES, 2,280 doctorate degrees in chemistry were awarded in 1992, 2% more than the year before. NSF recorded 2,222 such degrees in 1992, up 1% from 1991. The slightly different numbers come about because NCES collects its data from degree-granting institutions, whereas NSF surveys graduates directly. The American Chemical Society's Committee on Professional Training reports 2,202 chemistry Ph.D. graduates in 1992 from schools that have ACS-approved undergraduate curricula. That's 11 fewer than in 1991.

According to NSF data, U.S. citizens earned 59% of U.S. doctoral degrees in 1992, down substantially from their 76% share in 1982. Of the U.S. citizens earning Ph.D.s, 90% were white and 73% were male. A decade earlier, 93% were white and 84% were male. In fact, the decade saw a 1%-per-year decrease in the number of male U.S. citizens getting Ph.D. degrees in chemistry, while the number of women in this group rose 5% per year.

Asians, Hispanics, blacks, and Native Americans collectively earned a total 116 of the Ph.D. degrees in chemistry awarded to U.S. citizens in 1992, 12 fewer than in 1991. More than half of these degrees (63) went to Asians, 34 to Hispanics, 13 to blacks, and six to Native Americans. (An additional 20 degrees went to recipients who did not identify themselves according to ethnic group.)

The number of postdoctoral fellows in science and engineering grew 5% annually, from 14,672 in 1982 to 24,024 in 1992. However, unlike in all other disciplines, postdoctoral appointments in both chemistry and chemical engineering declined in 1992. Appointments in chemistry were off 2%, compared with a 2% annual growth for the decade as a whole; in chemical engineering, they fell 4%, compared with a hefty 12% annual rise since 1982.

In absolute expenditures in R&D, of course, the U.S. far outspends any other country. In 1992, for example, the U.S. spent more than twice as much as Japan and more than four times as much as Germany. And for that one year at least, the gap widened. After adjustment for inflation, U.S. R&D spending increased 3% in 1992 to $128 billion (constant 1987 dollars), matching its annual growth rate for the decade. In contrast, Japan cut its spending 1% to $56.5 billion, although for the decade as a whole, this spending rose at an annual rate of 6%. Germany's spending, which grew 4% annually for the decade as a whole, fell 1% in 1992 to $30.0 billion.

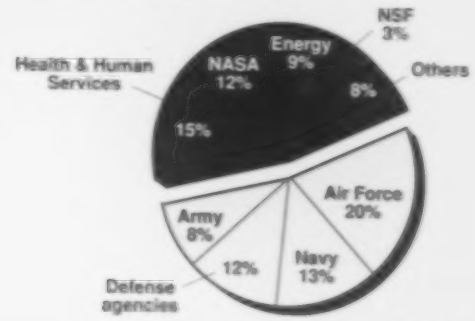
The U.S. boosted nondefense R&D spending 5% in 1992 to $94.5 billion. It had been growing at an annual rate of 3% since 1982. Both Japan and Germany, which allot virtually all of their R&D spending to nondefense work, dropped nondefense spending 1% to $56.0 billion and $28.7 billion, respectively.

Since 1989, the U.S. hasn't compared well with Japan in R&D spending as a percentage of gross domestic product. Share of GDP—the value of all goods and services produced in a country—is often used to compare the R&D efforts of different countries, because it takes into account differences in the economic base of each country. The fraction of GDP spent on R&D for the U.S. dropped from 2.7% in 1989 to 2.5% in 1991 and then rose in 1992 to 2.6%. During the same period, Japan's R&D spending ranged between 2.8 and 2.9% of GDP. The fraction of GDP spent on nondefense R&D in the U.S. held steady at 1.9%.

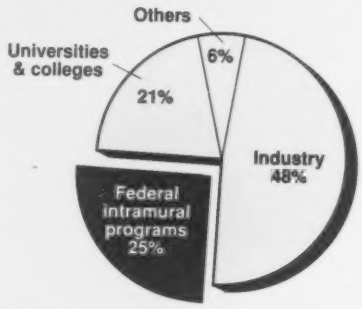
In 1993, the U.S. issued 30,743 chemical patents, of which 49% were issued to U.S. corporations, 9% to individuals in the U.S. and abroad, and 42% to corporations with foreign addresses. Japanese companies and individuals continued to claim the greatest share of U.S. chemical patents going abroad, claiming 22% of the total in 1993. In 1983, Japan received 15%. Both Italy and Belgium had sizable increases last year in the number of U.S. chemical patents they were awarded—Italy's take moved up 15% to 494 and Belgium's moved up 16% to 204. South Korea and Taiwan widened the dent they made in 1992 in the U.S. chemical patents market: South Korea was awarded 164 patents in 1993, up 61% from 1992; Taiwan received 147 patents, up 58%. □

Federal R&D Funding Flat This Year, Defense Loses Ground

Nondefense agencies fund 47% of federal R&D efforts . . .



. . . and government labs perform one quarter of federally funded R&D



Estimated fiscal 1994 federal obligations for R&D = $71.2 billion

Source: National Science Foundation

FEDERAL OBLIGATIONS FOR R&D: Commerce, EPA post strong gains, NSF rises also

$ Millions	1987	1988	1989	1990	1991	1992	1993[a]	1994[a]	% annual change 1993–94	% annual change 1987–94
Defense	$35,232	$35,249	$37,577	$37,268	$32,135	$36,130	$38,987	$37,523	–4%	1%
Air Force	15,348	14,867	15,237	14,831	10,938	13,427	13,889	13,994	1	–1
Navy	9,508	9,514	9,666	9,586	7,806	8,031	10,206	9,370	–8	0
Defense agencies	5,220	5,833	6,859	6,945	7,073	7,512	8,235	8,267	0	7
Army	5,020	4,806	5,659	5,684	6,082	6,854	6,404	5,608	–12	2
Health & Human Services	6,606	7,158	7,903	8,406	9,756	8,988	10,344	10,723	4	7
NIH[b]	6,327	6,846	7,474	7,980	9,157	8,409	9,771	10,075	3	7
NASA	3,787	4,330	5,394	6,533	7,280	7,658	8,190	8,637	5	12
Energy	4,757	5,036	5,193	5,631	5,983	6,172	6,586	6,582	0	5
NSF	1,471	1,533	1,670	1,690	1,785	1,868	2,073	2,217	7	6
Agriculture	948	1,017	1,038	1,108	1,237	1,327	1,331	1,368	3	5
Agricultural Research Service	479	506	524	546	591	627	626	640	2	4
Cooperative State Research Service	271	298	307	324	377	418	419	417	0	6
Forest Service	127	136	131	159	175	181	187	215	15	8
Commerce	402	389	398	438	490	651	736	899	22	12
National Oceanic & Atmospheric Administration	286	263	269	300	338	462	466	504	8	8
National Institute of Standards & Technology	99	108	116	122	140	179	261	382	46	21
Transportation	325	305	303	367	380	445	747	688	–8	11
EPA	348	347	390	420	433	484	521	656	26	9
Interior	404	417	469	509	593	609	612	589	–4	6
Geological Survey	227	236	260	308	357	361	355	362	2	7
Others	974	974	1,081	1,191	1,223	1,262	1,319	1,362	3	5
TOTAL	$55,254	$56,770	$61,406	$63,561	$61,295	$65,594	$71,446	$71,244	0%	4%
ANNUAL CHANGE	7%	3%	8%	4%	–4%	7%	9%	0%		

Note: Fiscal years. Does not include funds for R&D plant. a: Estimated. b: Includes funds previously reported for the Alcohol, Drug Abuse & Mental Health Administration, which became part of NIH in fiscal 1993. Source: "Survey of Federal Funds for Research and Development," National Science Foundation

PERFORMERS OF FEDERALLY FUNDED R&D: Federal intramural programs grow modestly

Federal obligations, $ millions	1987	1988	1989	1990	1991	1992	1993[a]	1994[a]	% annual change 1993–94	% annual change 1987–94
Industry	$28,628	$28,630	$30,508	$31,568	$28,489	$31,755	$34,705	$34,190	–1%	3%
FFRDCs[b] administered by industry	1,860	1,911	1,960	2,198	2,068	2,010	1,310	1,253	–4	–5
Federal intramural programs	13,413	14,115	15,121	15,978	15,238	15,690	17,199	17,542	2	4
Universities and colleges	10,548	11,302	12,169	12,588	13,773	14,127	14,831	14,909	1	5
FFRDCs[b] administered by universities	3,210	3,474	3,497	3,450	3,604	3,856	3,495	3,269	–6	0
Nonprofit institutions	2,222	2,189	2,522	2,870	3,316	3,550	4,183	4,078	–3	9
FFRDCs[b] administered by nonprofit institutions	511	506	522	622	679	746	823	902	10	8
Foreign	295	392	919	343	264	288	274	268	–2	–1
State and local governments	148	142	167	214	215	184	254	257	1	8
TOTAL	$55,254	$56,770	$61,406	$63,561	$61,295	$65,594	$71,446	$71,244	0%	4%
ANNUAL CHANGE	7%	3%	8%	4%	–4%	7%	9%	0%		

Note: Fiscal years. **a** Estimated. **b** Federally funded R&D centers. **Source:** "Survey of Federal Funds for Research and Development," National Science Foundation

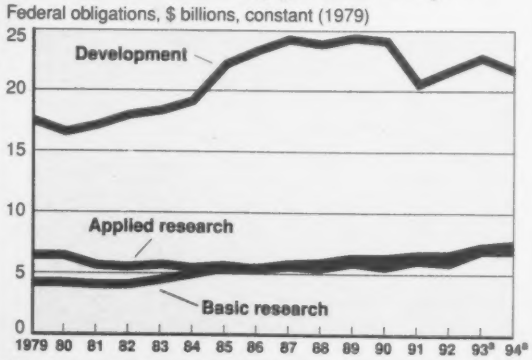
FEDERAL OBLIGATIONS FOR SCIENTIFIC DISCIPLINES: Chemistry gains 3% in fiscal 1994

$ Millions for research only	1987	1988	1989	1990	1991	1992	1993[a]	1994[a]	% annual change 1993–94	% annual change 1987–94
Life sciences	$ 7,341	$ 7,725	$ 8,495	$ 8,830	$ 9,622	$ 9,911	$10,950	$11,373	4%	6%
Engineering	3,906	3,956	4,442	4,227	4,945	4,977	5,840	6,006	3	6
Metallurgy and materials	362	457	521	555	711	727	714	842	18	13
Chemical	216	258	142	242	304	298	354	364	3	8
Physical sciences	3,253	3,317	3,705	3,809	4,235	4,439	4,916	4,833	–2	6
Physics	1,854	1,975	2,191	2,255	2,461	2,578	2,805	2,703	–4	6
Chemistry	680	703	783	762	828	896	1,023	1,052	3	6
Environmental sciences	1,512	1,607	1,773	2,174	2,150	2,208	2,412	2,542	5	8
Mathematical and computer sciences	641	643	735	841	904	1,160	1,363	1,469	8	13
Other sciences	1,288	1,402	1,616	1,741	2,112	1,796	1,971	1,901	–4	6
TOTAL	$17,941	$18,650	$20,766	$21,622	$23,968	$24,491	$27,452	$28,124	2%	7%
ANNUAL CHANGE	9%	4%	11%	5%	10%	8%	6%			

Note: Fiscal years. **a** Estimated. **Source:** "Survey of Federal Funds for Research and Development," National Science Foundation

In constant dollars, support for development is losing ground this year

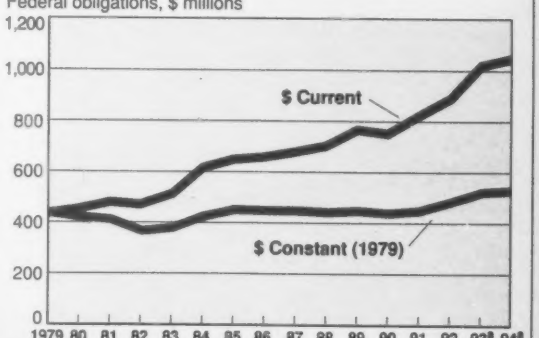
Federal obligations, $ billions, constant (1979)



Note: Fiscal years. Constant-dollar values calculated by C&EN from NSF data. **a** Estimated. **Source:** National Science Foundation

After three-year climb, real support for chemical research is leveling off

Federal obligations, $ millions



Note: Fiscal years. Constant-dollar values calculated by C&EN from NSF data. **a** Estimated. **Source:** National Science Foundation

FEDERAL OBLIGATIONS FOR BASIC RESEARCH: No gains for Energy or Defense, but NSF up 7%

$ Millions	1987	1988	1989	1990	1991	1992	1993[a]	1994[a]	% annual change 1993–94	% annual change 1987–94
Health & Human Services	$3,828	$4,081	$ 4,388	$ 4,649	$ 5,050	$ 5,059	$ 5,884	$ 6,067	3%	7%
NIH[b]	3,808	4,061	4,361	4,648	5,049	5,057	5,882	6,065	3	7
NSF	1,371	1,433	1,563	1,586	1,676	1,741	1,921	2,048	7	6
NASA	1,014	1,113	1,417	1,637	1,706	1,738	1,952	1,991	2	10
Energy	1,069	1,185	1,411	1,505	1,686	1,736	1,775	1,782	0	8
Defense	908	877	948	948	994	1,099	1,238	1,237	0	5
Navy	354	342	354	365	388	394	406	433	7	3
Defense agencies	115	173	204	201	208	294	381	347	–9	17
Air Force	222	196	203	197	209	206	239	246	3	1
Army	217	166	187	185	189	205	213	210	–1	0
Agriculture	446	481	485	519	558	595	597	631	6	5
Agricultural Research Service	253	271	283	294	310	326	326	335	3	4
Cooperative State Research Service	133	146	143	154	170	190	190	205	8	6
Forest Service	49	52	50	60	67	69	71	82	15	8
Interior	135	127	189	205	229	231	229	213	–7	7
Geological Survey	85	90	140	159	179	180	177	176	–1	11
Bureau of Mines	46	32	44	41	43	44	46	29	–37	–6
EPA	31	27	51	74	91	110	114	180	58	29
Smithsonian Institution	72	75	80	84	98	98	100	101	1	5
Commerce	26	31	29	31	34	35	37	40	8	6
National Institute of Standards & Technology	25	26	28	29	32	34	37	40	8	7
Others	42	44	41	48	49	48	50	56	12	4
TOTAL	$8,942	$9,474	$10,602	$11,286	$12,171	$12,490	$13,897	$14,346	3%	7%
ANNUAL CHANGE	10%	6%	12%	6%	8%	3%	11%	3%		

Note: Fiscal years. a Estimated. b Includes funds previously reported for the Alcohol, Drug Abuse & Mental Health Administration, which became part of NIH in fiscal 1993.
Source: "Survey of Federal Funds for Research and Development," National Science Foundation

FEDERAL OBLIGATIONS FOR APPLIED RESEARCH: NASA gets big increase, but Defense loses

$ Millions	1987	1988	1989	1990	1991	1992	1993[a]	1994[a]	% annual change 1993–94	% annual change 1987–94
Health & Human Services	$2,194	$2,416	$ 2,700	$ 2,818	$ 3,112	$ 2,887	$ 3,257	$ 3,418	5%	7%
NIH[b]	1,980	2,173	2,393	2,489	2,568	2,341	2,716	2,801	3	5
Defense	2,440	2,362	2,708	2,582	2,724	2,975	3,637	3,179	–13	4
Defense agencies	751	792	1,038	965	945	1,163	1,409	1,245	–12	7
Air Force	563	577	605	579	621	585	740	766	4	4
Army	693	588	636	595	672	728	857	631	–26	–1
Navy	433	406	429	443	486	499	632	536	–15	3
NASA	1,256	1,219	1,461	1,424	1,667	1,491	1,606	2,105	31	8
Energy	1,029	1,051	1,021	1,066	1,587	1,676	1,827	1,731	–5	8
Commerce	313	312	322	346	415	561	596	703	18	12
National Oceanic & Atmospheric Administration	234	225	235	252	316	439	426	469	10	10
National Institute of Standards & Technology	64	73	78	83	93	116	163	225	38	20
Agriculture	473	505	517	542	618	666	667	669	0	5
Agricultural Research Service	201	208	209	218	241	257	257	261	2	4
Cooperative State Research Service	138	153	165	171	206	229	229	212	–7	6
Forest Service	74	80	78	94	104	107	110	127	15	8
Transportation	69	91	121	119	115	156	330	279	–15	22
EPA	246	241	223	242	262	294	327	397	21	7
Interior	247	266	253	270	324	340	344	332	–3	4
Geological Survey	132	136	127	134	159	164	165	174	5	4
NSF	99	100	108	103	109	127	151	170	13	8
Others	632	614	730	825	865	827	813	795	–2	3
TOTAL	$8,998	$9,177	$10,164	$10,337	$11,798	$12,000	$13,555	$13,778	2%	6%
ANNUAL CHANGE	8%	2%	11%	2%	14%	2%	13%	2%		

Note: Fiscal years. a Estimated. b Includes funds previously reported for the Alcohol, Drug Abuse & Mental Health Administration, which became part of NIH in fiscal 1993.
Source: "Survey of Federal Funds for Research and Development," National Science Foundation

FEDERAL OBLIGATIONS FOR DEVELOPMENT: Commerce's budget up 50%, led by gains for NIST

$ Millions	1987	1988	1989	1990	1991	1992	1993[a]	1994[a]	% annual change 1993–94	% annual change 1987–94
Defense	$31,884	$32,010	$33,921	$33,739	$28,417	$32,056	$34,111	$33,107	–3%	1%
Air Force	14,563	14,094	14,430	14,055	10,107	12,637	12,911	12,982	1	–2
Navy	8,721	8,766	8,883	8,779	6,932	7,138	9,168	8,401	–8	–1
Defense agencies	4,354	4,868	5,617	5,780	5,919	6,114	6,445	6,674	4	6
Army	4,110	4,052	4,836	4,904	5,221	5,922	5,334	4,767	–11	2
NASA	1,518	1,999	2,515	3,473	3,909	4,428	4,632	4,541	–2	17
Energy	2,659	2,801	2,761	3,060	2,710	2,760	2,984	3,069	3	2
Health & Human Services	584	661	814	939	1,594	1,042	1,203	1,238	3	11
NIH[b]	538	613	720	842	1,450	1,011	1,173	1,209	3	12
Transportation	256	213	183	247	265	288	414	407	–2	–7
Commerce	64	47	47	61	40	55	103	154	50	13
National Institute of Standards & Technology (NIST)	9	9	10	11	16	30	61	116	90	44
National Oceanic & Atmospheric Administration	52	35	34	48	22	24	40	35	–13	–5
EPA	71	80	107	105	80	80	80	79	–1	2
Agriculture	29	31	36	47	61	66	67	68	1	13
Agricultural Research Service	24	26	31	33	40	44	44	44	0	9
Interior	22	24	27	33	40	39	39	44	13	10
Geological Survey	10	11	13	15	18	17	13	12	–8	3
Others	226	253	230	233	211	288	360	413	15	9
TOTAL	$37,313	$38,119	$40,641	$41,937	$37,327	$41,102	$43,993	$43,120	–2%	2%
ANNUAL CHANGE	7%	2%	7%	3%	–11%	10%	7%	–2%		

Note: Fiscal years. a Estimated. b Includes funds previously reported for the Alcohol, Drug Abuse & Mental Health Administration, which became part of NIH in fiscal 1993.
Source: "Survey of Federal Funds for Research and Development," National Science Foundation

ENGINEERING RESEARCH: Energy contributes 40% of funding for chemical engineering in

Federal obligations, $ millions	1989 All engineering	1989 Chemical engineering	1989 Metallurgy & materials	1990 All engineering	1990 Chemical engineering	1990 Metallurgy & materials	1991 All engineering	1991 Chemical engineering	1991 Metallurgy & materials
Defense	$1,836.2	$ 46.9	$343.4	$1,762.2	$ 37.4	$370.5	$1,938.0	$ 41.9	$493.1
Defense agencies	480.5	0.2	221.6	466.7	1.8	42.6	606.2	0	320.2
Air Force	565.1	11.6	42.9	509.8	0	240.8	498.2	3.3	39.7
Navy	389.9	11.6	56.1	408.8	11.5	59.7	403.4	9.6	88.8
Army	400.6	23.4	22.7	377.0	24.0	27.3	430.3	29.0	44.5
NASA	1,446.4	6.0	35.5	1,324.6	14.3	59.8	1,478.0	12.9	74.3
Energy	406.1	4.5	78.0	435.6	105.9	78.5	723.6	142.3	72.9
NSF	232.0	42.5	28.1	171.6	35.9	7.8	262.7	49.2	28.9
Transportation	87.6	6.9	0.2	91.9	7.0	0.2	78.9	6.1	0.6
Commerce	52.7	3.2	11.6	56.8	3.9	11.8	65.6	4.5	14.9
EPA	52.7	19.2	0.8	61.5	24.5	0.7	60.9	31.4	0.2
Interior	92.8	5.8	23.4	88.4	5.8	25.1	97.5	7.1	25.1
Agriculture	34.5	7.2	0	38.9	7.3	0	435.0	7.9	0
TOTAL	$4,241.0	$142.2	$521.0	$4,031.5	$242.0	$554.4	$5,140.2	$303.3	$710.0
ANNUAL CHANGE	13%	–45%	14%	–5%	70%	6%	28%	25%	28%

Note: Fiscal years. These nine agencies provide 95% of all engineering funds and 100% of funds for chemical and metallurgy and materials engineering. a Estimated.
Source: "Survey of Federal Funds for Research and Development," National Science Foundation

FEDERAL OBLIGATIONS FOR CHEMICAL RESEARCH: Three agencies provide 55% of support

$ Millions	1987	1988	1989	1990	1991	1992	1993[a]	1994[a]	% annual change 1993–94	% annual change 1987–94
Energy	$145.5	$162.9	$213.4	$189.2	$187.6	$219.3	$ 233.2	$ 221.0	–5%	6%
NSF	115.3	120.6	127.4	133.2	151.7	135.4	180.5	190.3	5	7
NIH[b,c]	115.5	123.8	107.9	112.2	119.9	136.7	160.1	164.9	3	5
Defense	144.9	125.0	133.5	121.0	138.5	136.6	158.3	151.8	–4	1
Air Force	43.3	43.6	43.2	41.2	43.2	46.7	57.9	46.0	–21	1
Army	72.2	57.5	60.4	50.4	54.0	39.1	44.1	45.6	3	–6
Navy	28.4	22.1	25.5	26.5	38.4	37.4	41.2	40.5	–2	5
Defense agencies	1.1	1.8	4.4	2.8	3.0	13.4	15.1	19.7	30	51
EPA	34.6	30.6	32.5	37.1	49.6	74.7	82.3	102.1	24	17
Agriculture	65.0	60.8	61.0	67.8	76.0	82.8	84.0	83.9	0	4
Agricultural Research Service	46.4	40.9	41.3	43.1	47.5	51.3	52.3	53.5	2	2
Cooperative State Research Service	11.5	12.2	12.3	15.6	18.5	24.7	24.6	22.2	–10	10
Forest Service	7.1	7.6	7.5	9.0	10.0	6.9	7.1	8.1	14	2
NASA	13.4	27.5	47.4	35.9	39.2	47.5	57.1	60.6	6	24
Commerce	22.9	23.6	24.4	25.0	27.1	29.6	33.4	40.1	20	8
National Institute of Standards & Technology	16.5	16.9	17.7	18.4	19.3	20.8	24.9	31.0	24	9
National Oceanic & Atmospheric Administration	6.4	6.7	6.7	6.7	7.8	8.8	8.6	9.1	6	5
Interior	20.9	21.9	22.0	22.9	28.2	24.9	26.2	29.0	11	5
Geological Survey	20.2	20.8	21.9	22.9	28.2	24.9	25.2	27.5	9	5
Others	2.3	6.4	13.1	17.4	10.6	9.0	7.7	8.4	9	20
TOTAL	$680.3	$703.1	$782.6	$761.7	$828.4	$896.5	$1,022.8	$1,052.1	3%	6%
ANNUAL CHANGE	3%	3%	11%	–3%	9%	8%	14%	3%		

Note: Fiscal years. a Estimated. b Part of Department of Health & Human Services; all HHS support for chemical research comes from NIH. c Includes funds previously reported for the Alcohol, Drug Abuse & Mental Health Administration, which became part of NIH in fiscal 1993. **Source:** "Survey of Federal Funds for Research and Development," National Science Foundation

fiscal 1994, NSF and EPA give an additional 36%

1992			1993[a]			1994[a]		
All engineering	Chemical engineering	Metallurgy & materials	All engineering	Chemical engineering	Metallurgy & materials	All engineering	Chemical engineering	Metallurgy & materials
$2,032.7	$ 34.7	$521.6	$2,459.7	$ 43.2	$465.0	$2,251.0	$ 35.2	$522.0
751.0	5.3	311.6	871.6	5.6	288.3	777.6	7.8	284.6
440.2	3.1	91.3	537.1	4.1	37.3	579.0	4.4	114.1
409.1	7.9	84.9	491.2	10.1	99.7	441.2	8.8	92.4
432.3	18.3	33.8	559.8	23.5	39.7	453.2	14.2	30.9
1,367.8	13.3	67.4	1,517.7	18.1	79.4	1,884.8	14.6	143.6
711.3	135.1	67.1	764.6	152.9	74.6	722.1	143.5	70.5
217.1	45.5	21.9	283.3	56.0	30.4	307.4	61.0	32.0
92.6	0.4	0.9	207.9	10.5	10.4	181.0	10.4	11.8
84.4	4.8	20.1	108.7	6.4	26.7	141.5	8.2	36.3
79.1	44.8	0.4	80.8	47.6	0.3	121.5	69.4	0.3
112.5	9.0	27.8	115.4	9.6	27.0	91.2	10.4	25.8
65.3	7.1	0	66.5	7.4	0	66.3	7.9	0
$4,762.8	$294.7	$727.2	$5,604.6	$351.7	$713.8	$5,766.8	$360.6	$842.3
–7%	–3%	2%	18%	2%	–2%	3%	3%	18%

UNIVERSITY RESEARCH: Funding for chemistry accounts for a third of physical sciences budget

Federal obligations, $ millions	1987	1988	1989	1990	1991	1992	1993[a]	1994[a]	% annual change 1993–94	% annual change 1987–94
Life sciences	$3,824	$4,029	$4,396	$4,532	$4,967	$5,011	$5,581	$5,715	2%	6%
Physical sciences	823	857	930	1,002	1,071	1,151	1,277	1,298	2	7
Physics	404	425	486	546	591	574	672	672	0	8
Chemistry	281	295	298	317	340	352	411	431	5	6
Engineering	600	673	749	713	829	836	934	984	5	7
Metallurgy and materials	108	175	194	166	214	183	186	192	3	9
Chemical	55	57	42	59	76	70	81	83	2	6
Environmental sciences	400	408	460	489	489	585	665	688	3	8
Mathematical and computer sciences	289	305	345	415	399	478	542	596	10	11
Other sciences	449	494	593	636	709	586	684	693	1	6
TOTAL	$6,385	$6,766	$7,473	$7,787	$8,464	$8,647	$9,683	$9,974	3%	7%
ANNUAL CHANGE	14%	6%	10%	15%	9%	2%	12%	3%		

Note: Fiscal years. Includes funding only from six agencies that together represent about 96% of federal research support to universities in fiscal 1994. a Estimated.
Source: "Survey of Federal Funds for Research and Development," National Science Foundation

UNIVERSITY RESEARCH IN CHEMISTRY: NSF provides 43% of total support

Federal obligations, $ millions	1987	1988	1989	1990	1991	1992	1993[a]	1994[a]	% annual change 1993–94	% annual change 1987–94
NSF	$107.1	$111.6	$118.5	$130.6	$150.3	$133.9	$176.1	$186.2	6%	8%
NIH[b,c]	85.0	91.4	76.4	79.9	83.7	94.0	107.6	109.3	2	4
Defense	45.0	41.3	42.0	41.9	41.5	50.9	53.5	62.3	16	5
Defense agencies	17.2	13.6	14.3	16.2	15.8	13.4	14.3	19.1	34	50
Air Force	18.4	17.0	15.5	17.1	15.8	14.6	15.2	19.0	25	0
Navy	1.1	1.8	4.4	2.8	3.0	16.0	17.1	18.0	5	1
Army	8.3	8.8	7.7	5.8	6.8	6.9	6.9	6.2	–10	–4
Energy	28.5	33.8	43.7	44.7	39.9	44.3	44.2	45.6	3	7
Agriculture	11.2	11.8	11.8	14.4	18.6	23.4	23.4	20.9	–11	9
NASA	4.3	4.8	5.2	6.0	5.7	5.2	5.5	6.7	3	7
TOTAL	$281.1	$294.7	$297.7	$317.5	$339.7	$351.7	$411.3	$431.0	5%	6%
ANNUAL CHANGE	6%	5%	1%	7%	7%	4%	17%	5%		

Note: Fiscal years. Funding from these six agencies represent about 96% of federal obligations in fiscal 1994. a Estimated. b Part of Department of Health & Human Services; all HHS support for chemical research comes from NIH. c Includes funds previously reported for the Alcohol, Drug Abuse & Mental Health Administration, which became part of NIH in fiscal 1993.
Source: "Survey of Federal Funds for Research and Development," National Science Foundation

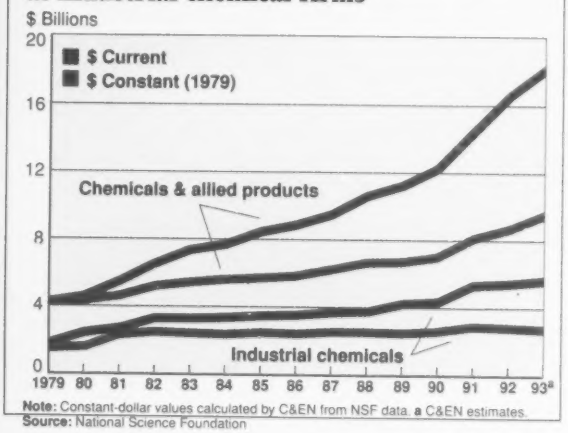
FEDERAL OBLIGATIONS FOR R&D PLANT: NSF gains 34% amidst a general plunge

$ Millions	1987	1988	1989	1990	1991	1992	1993[a]	1994[a]	% annual change 1993–94	% annual change 1987–94
Energy	$ 772.2	$ 915.0	$ 873.0	$ 916.0	$1,220.1	$1,320.8	$1,424.3	$1,471.5	3%	10%
NASA	309.4	428.2	519.5	527.0	723.6	817.8	990.8	871.6	–12	16
Defense	477.2	435.8	499.3	487.3	425.7	396.5	518.6	260.5	–50	–8
Air Force	270.3	143.7	250.2	322.2	152.3	179.7	249.5	106.3	–57	–12
Navy	69.0	74.9	89.6	60.4	54.0	96.0	35.0	70.0	100	0
Defense agencies	72.1	124.4	114.4	51.6	128.4	98.8	214.1	48.2	–77	–6
Army	65.8	92.8	45.1	53.1	91.0	22.0	20.0	36.0	80	–8
NSF	61.3	56.9	53.6	39.3	159.6	101.6	137.9	185.4	34	17
Health & Human Services	36.7	19.5	78.6	107.8	86.3	96.7	375.6	159.2	–58	23
NIH[b]	35.9	19.0	55.6	84.8	67.8	82.1	340.8	128.9	–62	20
Agriculture	111.8	135.2	89.2	102.2	144.6	164.7	197.4	94.6	–52	–2
Commerce	5.2	11.2	9.1	15.4	15.7	21.0	131.2	79.2	–40	48
National Institute of Standards & Technology	2.0	10.7	8.6	8.8	8.5	11.2	116.9	68.7	–41	65
Others	72.2	55.3	42.8	76.7	77.2	65.5	82.6	70.3	–15	0
TOTAL	$1,846.0	$2,057.1	$2,165.1	$2,271.7	$2,852.8	$2,984.6	$3,858.4	$3,192.3	–17%	8%
ANNUAL CHANGE	20%	11%	5%	5%	26%	5%	29%	–17%		

Note: Fiscal years. a Estimated. b Includes funds previously reported for the Alcohol, Drug Abuse & Mental Health Administration, which became part of NIH in fiscal 1993.
Source: "Survey of Federal Funds for Research and Development," National Science Foundation

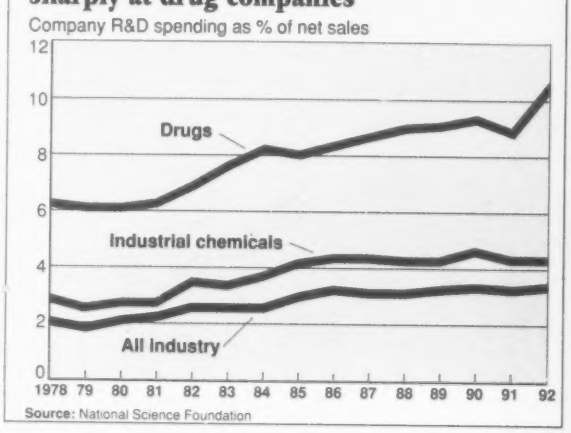
Chemical Industry R&D Spending Rises 4% To $126 Billion

In real terms, R&D spending levels off at industrial chemical firms



Note: Constant-dollar values calculated by C&EN from NSF data. a C&EN estimates.
Source: National Science Foundation

Share of revenue spent on R&D jumps sharply at drug companies



Source: National Science Foundation

TOTAL FUNDS FOR INDUSTRIAL R&D: Chemical firms perform 14% of total R&D

$ Millions	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	% annual change 1992–93	% annual change 1983–93
Chemicals and allied products	$ 7,185	$ 7,927	$ 8,540	$ 8,843	$ 9,635	$10,772	$ 11,466	$ 12,344	$ 14,648	$ 16,711	$ 18,350[a]	10%	10%
Industrial chemicals	3,214	3,240	3,498	3,552	3,716	3,959	4,039	4,337	5,390	5,406	5,450[a]	1	5
Drugs	2,901[a]	3,316[a]	3,490[a]	3,658	4,100[a]	4,746	5,427[a]	6,025[a]	6,950[a]	8,831	10,300[a]	17	14
Other chemicals	1,070[a]	1,371[a]	1,552[a]	1,633	1,819[a]	2,067	2,100[a]	2,182[a]	2,306[a]	2,474	2,600[a]	5	9
Other industries	58,083	66,873	75,699	78,980	82,520	87,117	90,388	92,000	102,304	104,603	107,550[a]	3	6
TOTAL	$65,268	$74,800	$84,239	$87,823	$92,155	$97,889	$101,854	$104,344	$116,952	$121,314	$125,900[b]	4%	7%

Note: Monies are for R&D performed in the U.S. a C&EN estimates. b Preliminary data. **Source:** "Research and Development in Industry," National Science Foundation

COMPANY FUNDS FOR INDUSTRIAL R&D: Outlays for drug R&D jumps 25% in 1992

$ Millions	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	% annual change 1991–92	% annual change 1982–92
Chemicals and allied products	$ 6,197	$ 6,792	$ 7,736	$ 8,310	$ 8,664	$ 9,445	$10,573	$11,383	$12,277	$14,439	$16,420	14%	10%
Industrial chemicals	2,810	2,828	3,057	3,281	3,374	3,531	3,763	3,960	4,272	5,225	5,152	1	6
Drugs	2,473	2,896	3,310	3,481	3,657	4,095	4,743	5,164	5,366	6,947	8,822	25	14
Other chemicals	914	1,068	1,369	1,548	1,633	1,819	2,067	2,259	2,638	2,267	2,447	8	10
Other industries	33,908	37,796	43,668	48,733	51,268	51,958	55,199	59,179	61,703	76,141	80,234	5	9
TOTAL[a]	$40,105	$44,588	$51,404	$57,043	$59,932	$61,403	$65,772	$70,562	$73,980	$90,580	$96,654	7%	9%

Note: Monies are for R&D performed in the U.S. and include funds from nonfederal sources such as research institutions, nonprofit organizations, and the like. a Totals may not add because of rounding. **Source:** "Research and Development in Industry," National Science Foundation

FEDERAL FUNDS FOR INDUSTRIAL R&D: Chemical industry's share is growing rapidly

$ Millions	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	% annual change 1991–92	% annual change 1982–92
Chemicals and allied products	$407	$393	$191[a]	$230	$179	$192	$199	$83	$67	$209	$291	39%	–6%
Industrial chemicals	396	386	183[a]	217	178	187	196	79	65	165	254	54	–4
Drugs and other chemicals	11	7	8	13	1	5	3	4	2	44[b]	36[b]	8	9
Other industries	18,138	20,287	23,205	26,966	27,712	31,119	31,918	31,209	30,559	26,163	24,369	–7	3
TOTAL	$18,545	$20,680	$23,396	$27,196	$27,891	$31,311	$32,117	$31,292	$30,626	$26,372	$24,660	–6%	3%

Note: Monies are for R&D performed in the U.S. **a** The decline in 1984 from 1983 results from the administration of federally funded Oak Ridge National Laboratory being changed from a chemical company to a company in the aircraft and missile industry. **b** C&EN estimates. **Source:** "Research and Development in Industry," National Science Foundation

R&D BY U.S. COMPANIES ABROAD: Funds spent by drug firms increase 18% in 1992

$ Millions	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	% annual change 1991–92	% annual change 1982–92
Chemicals and allied products	$ 682	$ 729	$ 786	$ 843	$1,071	$1,243	$1,501	$1,504	$1,990	$2,401	$2,683	12%	15%
Industrial and other chemicals	319	368	385	444	579	625	781	508	547	1,009	1,042	3	13
Drugs	363	361	401	399	492	618	720	996	1,443	1,392	1,641	18	16
Other industries	2,412	2,540	2,847	2,807	3,553	3,983	4,794	5,310	5,737	6,746	7,298	8	12
TOTAL	$3,094	$3,269	$3,633	$3,650	$4,624	$5,226	$6,295	$6,814	$7,727	$9,147	$9,981	9%	12%

Source: "Research and Development in Industry," National Science Foundation

R&D SPENDING: Drug firms register 8% rise, chemical firms post 3% decline in 1993

$ Millions	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993 R&D spending as % of sales
CHEMICAL COMPANIES												
Dow Chemical	$ 492	$ 507	$ 547	$ 605	$ 670	$ 772	$ 873	$1,136	$1,159	$1,289	$1,256	7.0%
DuPont	966	1,097	1,144	1,156	1,223	1,319	1,387	1,428	1,298	1,277	1,132	3.1
Monsanto	290	370	470	596	615	648	598	612	627	651	626	7.9
Rohm and Haas	100	109	124	133	142	156	175	178	183	199	205	6.3
Lubrizol	37	33	44	51	62	65	70	74	80	90	172	11.3
Union Carbide	245	265	275	148	159	159	181	191	190	155	139	3.0
W. R. Grace	73	81	92	94	107	119	125	148	150	151	135	3.1
Air Products[a]	40	44	51	61	57	72	71	72	80	85	92	2.8
Ethyl[b]	39	40	47	47	50	59	61	65	69	73	76	3.9
Hercules	74	72	76	71	74	74	79	92	86	70	76	2.7
International Flavors	32	32	34	39	45	50	52	57	62	71	75	6.3
Morton International[c]	23	30	25	29	31	35	38	48	59	61	69	3.0
Praxair[d]	—	—	—	—	—	—	—	—	—	62	58	2.4
Nalco	30	32	32	33	35	37	41	45	47	48	50	3.6
Olin	49	52	53	56	62	58	66	66	41	39	41	1.7
Petrolite[e]	13	12	12	12	12	12	12	12	11	12	14	3.9
TOTAL	$2,503	$2,776	$3,026	$3,122	$3,344	$3,635	$3,829	$4,224	$4,142	$4,333	$4,216	4.4%
ANNUAL CHANGE	8%	11%	9%	3%	7%	9%	5%	10%	–2%	5%	–3%	
PHARMACEUTICAL COMPANIES												
Merck & Co.	$ 356	$ 393	$ 426	$ 480	$ 566	$ 669	$ 751	$ 854	$ 998	$1,112	$1,173	11.2%
Bristol-Myers Squibb	301	344	412	474	563	688	789	881	993	1,083	1,128	9.9
Pfizer	230	255	287	336	401	473	531	640	757	863	974	13.0
Eli Lilly	294	341	370	427	466	512	605	703	767	925	955	14.8
Upjohn	218	247	284	314	356	380	407	427	491	549	642	17.8
American Cyanamid	208	232	251	278	314	365	406	460	492	566	596	13.9
Schering-Plough	145	164	175	212	251	298	327	380	426	522	578	13.3
TOTAL	$1,752	$1,976	$2,205	$2,521	$2,917	$3,385	$3,816	$4,345	$4,924	$5,620	$6,046	12.6%
ANNUAL CHANGE	14%	13%	12%	14%	16%	16%	13%	14%	13%	14%	8%	

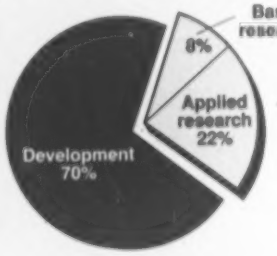
Note: Prior years are not restated to reflect company revisions. **a** For fiscal year ending Sept. 30. **b** Beginning in 1989, excludes Tredegar Industries, spun off in 1989. **c** For fiscal year ending June 30, includes all company-financed R&D but excludes contract R&D; data for Morton Thiokol prior to 1985. **d** Spun off from Union Carbide in 1992. **e** For fiscal year ending Oct. 31. **Source:** Company data

CHEMISTS IN INDUSTRY: Nonmanufacturing firms draw 15%

Industry	% of industrial chemists[a]				Mean salary ($ thousands)[b]		
	All chemists	B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
MANUFACTURING							
Pharmaceuticals[c]	22%	18%	24%	24%	$49.6	$55.9	$79.1
Specialty chemicals	13	12	12	14	48.9	55.9	70.8
Basic chemicals	5	3	3	7	51.4	55.5	71.2
Plastics	4	3	4	5	49.0	62.7	76.1
Coatings	4	6	4	3	46.9	57.6	66.8
Medical devices	4	3	4	5	43.8	61.8	71.4
Petroleum and natural gas	3	3	2	4	49.1	56.9	79.6
Agricultural chemicals	3	3	4	4	46.9	55.0	72.7
Food	3	4	4	2	44.6	57.2	69.0
Instruments	3	3	3	3	46.4	58.9	65.1
Electronics	2	2	2	3	43.5	56.0	74.3
Aerospace	2	1	2	2	52.4	53.0	71.5
Rubber	2	2	2	1	47.0	57.5	63.3
Soaps and detergents	2	2	—	2	47.0	—	75.0
Metals and minerals	2	3	—	1	43.2	—	69.8
Biochemical products	2	1	2	2	48.2	50.2	70.3
Paper	1	1	1	1	43.6	45.9	67.9
Other	8	8	9	8	43.5	58.3	70.7
NONMANUFACTURING							
Analytical service labs	6	12	7	2	41.3	48.6	59.3
Contract research firms	3	2	3	4	40.5	58.0	65.9
Utilities	1	2	2	—	49.8	56.2	—
Other	5	6	5	4	41.1	56.7	68.0

a Totals may not add up because of rounding. b As of March 1, 1994; to facilitate comparison, mean salaries are adjusted for differences in average length of experience. c Includes personal care products. **Source:** ACS survey

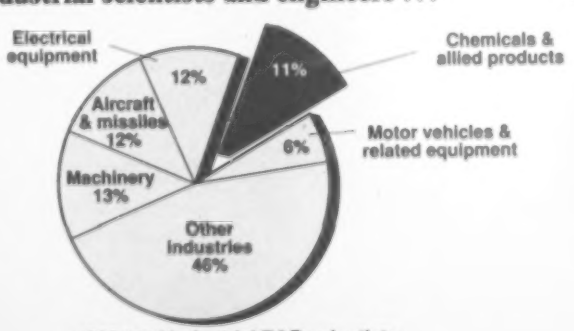
Development accounts for 70% of industrial R&D funds



Estimated total 1993 industrial R&D spending = $126 billion

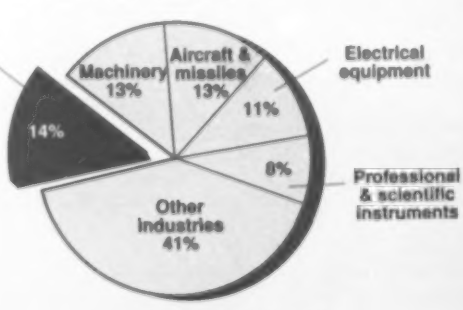
Source: National Science Foundation

Chemical producers employ 11% of industrial scientists and engineers . . .



1993 total industrial R&D scientists and engineers[a] = 787,100

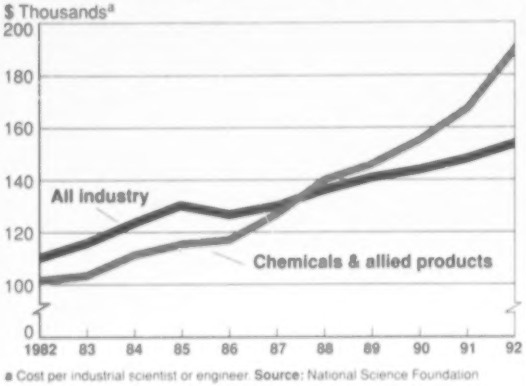
. . . and spend 14% of total industrial R&D funds in the U.S.



1992[b] total industrial R&D expenditures = $121 billion

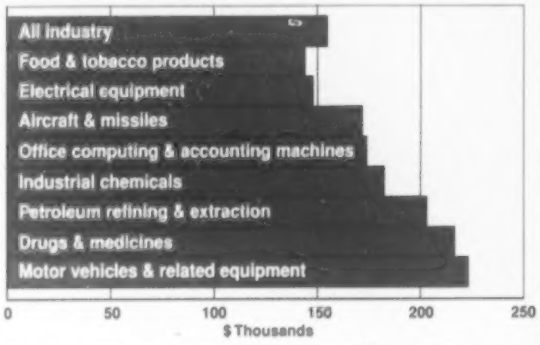
a Data as of January 1993 for full-time equivalent personnel. b Latest year for which data are available. **Source:** National Science Foundation

Cost per R&D scientist in chemical firms has nearly doubled since 1982



a Cost per industrial scientist or engineer. **Source:** National Science Foundation

Auto industry spends the most for its R&D scientists and engineers



a Cost per industrial scientist or engineer. **Source:** National Science Foundation

R&D SCIENTISTS AND ENGINEERS PER 1,000 EMPLOYEES: Drug firms lead in chemical fields

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Chemicals and allied products	**51**	**54**	**57**	**57**	**70**	**68**	**70**	**72**	**74**	**69**	**76**
Industrial chemicals	44	45	41	39	56	52	55	56	57	60	66
Drugs	74	82	89	81	98	98	99	98	110	95	108
Other chemicals	37	39	51	62	63	61	61	63	61	53	53
Petroleum refining and extraction	**22**	**22**	**22**	**21**	**19**	**20**	**24**	**25**	**25**	**26**	**28**
Machinery	**48**	**57**	**56**	**60**	**64**	**67**	**68**	**76**	**81**	**74**	**74**
Office, computing, and accounting machines	80	88	90	99	107	115	116	133	142	137	139
Electrical Equipment	**55**	**51**	**49**	**53**	**59**	**65**	**70**	**70**	**73**	**67**	**66**
Transportation equipment	**na**	**na**	**na**	**71**	**69**	**68**	**73**	**73**	**72**	**73**	**75**
Motor vehicles and related equipment	31	30	27	28	38	42	41	43	45	49	49
Aircraft and missiles	94	102	110	116	99	91	101	100	96	98	105
ALL INDUSTRY	**33**	**34**	**40**	**43**	**45**	**45**	**47**	**49**	**50**	**50**	**47**

na = not available. **Source:** "Research and Development in Industry," National Science Foundation

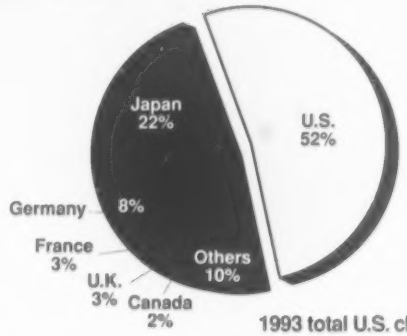
R&D SCIENTISTS AND ENGINEERS IN INDUSTRY: Pharmaceutical firms gain 10%

												% annual change	
Thousands	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1992–93	1983–93
Chemicals and allied products	**67.3**	**69.8**	**71.1**	**75.8**	**75.2**	**75.8**	**77.6**	**78.9**	**78.8**	**85.6**	**89.2**	**4%**	**3%**
Industrial chemicals	26.6	25.6	23.5	24.9	22.4[a]	22.5[a]	23.1[a]	23.0[a]	22.7[a]	29.9	29.6	–1	1
Drugs	28.2	30.8[a]	30.8	31.8	32.6	33.0	34.0	33.5	34.2	38.7	42.6	10	4
Other chemicals	12.1	13.4	16.7	19.1	20.2	20.3	20.5	22.4	21.9	17.0	17.0	0	4
Other industries	**473.6**	**514.3**	**551.4**	**595.2**	**620.6**	**632.8**	**642.6**	**652.0**	**625.3**	**693.7**	**697.9**	**1**	**4**
TOTAL	**540.9**	**584.1**	**622.5**	**671.0**	**695.8**	**708.6**	**720.2**	**730.9**	**704.1**	**779.3**	**787.1**	**1%**	**4%**

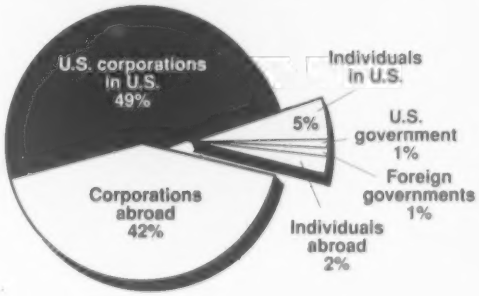
Note: Data as of January of each year for full-time equivalent personnel. a C&EN estimates. **Source:** "Research and Development in Industry," National Science Foundation

U.S. Chemical Patents Issued In 1993 Up 4%, Topping 30,000

Nearly half of U.S. chemical patents originate outside the U.S. . . .



. . . and 91% are owned by corporations—both in the U.S. and abroad



1993 total U.S. chemical patents assigned = 30,743

Note: Origin of patent is based on address of inventor whose name is first on patent application. For corporations, it is based on address of company named on patent application.
Source: U.S. Patent & Trademark Office

ORIGIN OF U.S. CHEMICAL PATENTS: South Korea, Taiwan rack up big gains

Number of patents issued[a]	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	% annual change 1992–93	% annual change 1983–93
U.S.	10,564	11,523	11,555	10,528	11,431	11,269	13,847	13,119	14,155	15,508	16,111	4%	4%
Japan	2,830	3,257	3,732	3,641	4,120	4,280	5,447	5,469	5,819	6,257	6,815	9	9
Germany[b]	1,995	2,140	2,180	2,077	2,269	2,340	2,798	2,704	2,670	2,702	2,586	–4	3
France	614	665	716	664	831	800	946	917	1,006	1,013	1,033	2	5
U.K.	702	847	854	713	756	849	1,009	953	970	911	883	–3	2
Canada	267	286	358	276	321	335	461	431	461	538	531	–1	7
Italy	219	259	296	277	288	315	417	408	426	429	494	15	9
Switzerland	434	454	458	413	444	433	504	474	473	427	452	6	0
Netherlands	220	227	198	196	234	236	332	283	337	289	320	11	4
Belgium	94	127	107	110	154	145	189	154	165	176	204	16	8
South Korea	5	10	9	7	11	13	29	52	82	102	164	61	42
Sweden	146	138	182	178	173	159	187	189	156	151	161	7	1
Taiwan	8	10	18	9	13	19	31	52	69	93	147	58	34
Finland	41	57	63	67	79	73	74	115	118	138	109	–21	10
Israel	37	45	37	50	70	63	99	82	87	98	105	7	11
Australia	59	76	69	70	95	85	106	87	124	93	93	0	5
Denmark	40	51	52	50	52	41	78	61	71	81	89	10	8
Austria	63	45	63	55	55	98	100	86	104	112	84	–25	3
Hungary	64	74	68	74	77	54	76	51	62	64	49	–23	–3
Other	234	236	240	219	248	225	490	317	301	302	313	4	3
TOTAL	**18,636**	**20,527**	**21,255**	**19,674**	**21,721**	**21,832**	**27,033**	**26,004**	**27,656**	**29,484**	**30,743**	**4%**	**5%**

Note: Origin of patent is based on address of inventor whose name is first on patent application. **a** Includes patents issued in those technology subclasses that the U.S. Patent & Trademark Office classifies as chemical. **b** Patents prior to October 1990 were issued to West Germany. **Source:** "Technology Assessment and Forecast Report, Chemical Classes," U.S. Patent & Trademark Office

OWNERS OF U.S. CHEMICAL PATENTS: U.S. corporations receive just under half

Number of patents assigned[a]	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Total 1984–93
U.S.	**12,282**	**12,390**	**11,196**	**12,154**	**12,001**	**14,819**	**14,043**	**15,067**	**16,341**	**16,966**	**137,259**
to U.S. corporations in the U.S.	10,960	11,061	9,970	10,763	10,718	13,210	12,417	13,441	14,483	15,154	122,177
to U.S. government	379	335	293	332	264	306	316	350	418	414	3,407
to individuals in the U.S.	943	994	933	1,059	1,019	1,303	1,310	1,276	1,440	1,398	11,675
Foreign	**8,245**	**8,865**	**8,478**	**9,567**	**9,831**	**12,214**	**11,961**	**12,589**	**13,143**	**13,777**	**108,670**
to corporations abroad	7,521	8,137	7,794	8,808	9,075	11,304	11,077	11,665	12,219	12,917	100,517
to foreign governments	166	161	150	200	170	176	155	201	194	180	1,753
to individuals abroad	558	567	534	559	586	734	729	723	730	680	6,400
TOTAL	**20,527**	**21,255**	**19,674**	**21,721**	**21,832**	**27,033**	**26,004**	**27,656**	**29,484**	**30,743**	**245,929**
% FOREIGN	**40.2%**	**41.7%**	**43.1%**	**44.0%**	**45.0%**	**45.2%**	**46.0%**	**45.5%**	**44.6%**	**44.8%**	**44.2%**

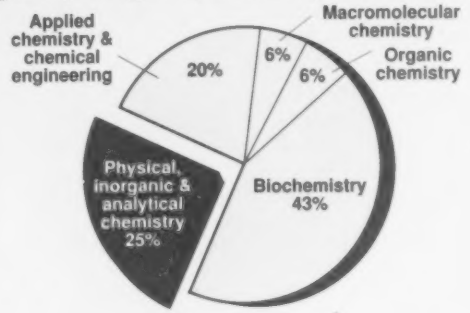
Note: Patent ownership for corporations is based on address of company named on patent application. a Includes patents issued in those technology subclasses that the U.S. Patent & Trademark Office classifies as chemical. **Source:** "Technology Assessment and Forecast Report, Chemical Classes," U.S. Patent & Trademark Office

PATENT ACTIVITY OF U.S. COMPANIES: Drug firms collect more, chemical firms slide

Number of utility patents issued	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Total 1984–93
CHEMICAL COMPANIES											
DuPont[a]	416	396	371	449	437	495	533	652	648	605	**5,002**
Dow Chemical	328	336	371	469	421	431	400	332	320	328	**3,736**
Dow Corning	52	55	69	58	82	105	122	135	144	93	**915**
Union Carbide	231	242	208	159	141	132	127[b]	131[b]	138[c]	119[d]	**1,628**
Monsanto	138	100	111	91	76	88	84	129	129	103	**1,049**
W. R. Grace	57	45	43	44	61	111	105	121	129	122	**838**
American Cyanamid	111	115	92	107	101	114	136	106	126	135	**1,143**
Olin	112	117	81	58	60	80	74	105	114	72	**873**
Ethyl	76	105	77	48	51	87	108	118	95	88	**853**
Air Products	60	80	61	85	70	119	98	119	90	110	**892**
PPG Industries	137	128	124	118	118	112	100	94	69	83	**1,083**
Nalco	32	32	26	50	52	55	54	49	69	59	**478**
International Specialty Products[e]	19	23	12	15	23	50	42	40	67	71	**362**
Rohm and Haas	37	31	33	22	18	32	32	49	65	116	**435**
Hercules	39	41	43	50	32	47	35	63	38	30	**418**
International Flavors & Fragrances	95	104	76	38	24	31	40	38	25	25	**496**
TOTAL[f]	**1,940**	**1,950**	**1,798**	**1,861**	**1,767**	**2,089**	**2,090**	**2,281**	**2,266**	**2,159**	**20,201**
ANNUAL CHANGE	**13%**	**1%**	**–8%**	**4%**	**–5%**	**18%**	**0%**	**9%**	**–1%**	**–5%**	
DRUG COMPANIES											
Merck	135	105	103	123	125	173	134	152	164	222	**1,436**
Bristol-Myers Squibb	87	110	105	125	120	116	123	124	129	119	**1,158**
Abbott Laboratories	32	36	29	30	39	39	64	79	128	127	**603**
Warner-Lambert	49	73	101	118	113	117	108	120	92	85	**976**
Pfizer	89	72	72	67	63	79	82	91	81	66	**762**
Hoffmann-LaRoche	78	74	84	86	59	93	78	78	72	87	**789**
Eli Lilly	80	107	82	85	68	75	73	66	63	79	**778**
American Home Products	32	49	38	46	69	78	66	46	56	66	**546**
Upjohn	109	66	66	26	15	30	26	23	31	30	**422**
TOTAL[f]	**691**	**692**	**680**	**706**	**671**	**800**	**754**	**779**	**814**	**881**	**7,470**
ANNUAL CHANGE	**22%**	**0%**	**–2%**	**4%**	**–5%**	**19%**	**–6%**	**3%**	**4%**	**8%**	

Note: Includes U.S. chemical and drug companies and U.S. subsidiaries of foreign companies that have received more than 1,000 U.S. patents since 1969. a Includes patents issued to Conoco. b Includes patents issued to Union Carbide Chemicals & Plastics, Union Carbide Chemicals & Plastics Technology, and Union Carbide Industrial Gases Technology. c Patents issued to Union Carbide Chemicals & Plastics Technology and Union Carbide Industrial Gases Technology. d Company data. e Patents were issued to GAF Chemicals from 1983 to 1991. f These totals include patents issued to companies in this table only. **Sources:** "Patenting by Organizations" and "All Technologies Report," U.S. Patent & Trademark Office

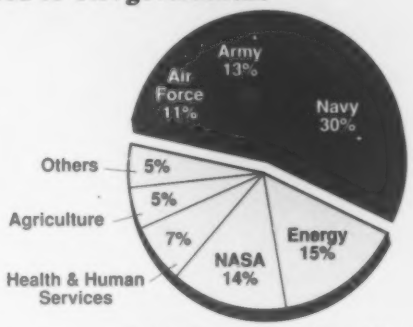
One fourth of chemistry papers are in physical, inorganic, and analytical fields



1993 total[a] = 448,733

a Number of abstracts of papers published in *Chemical Abstracts*.
Source: Chemical Abstracts Service

Defense gets more than half of patents issued to U.S. government



Total utility patents issued to U.S. government in 1993 = 1,165

Source: U.S. Patent & Trademark Office

PATENT ACTIVITY OF U.S. GOVERNMENT: Navy has been in forefront since 1990

Number of utility patents issued	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Total
Defense	653	596	594	525	322	425	498	687	580	629	5,509
Navy	285	248	216	170	103	125	265	381	297	344	2,434
Army	187	205	198	169	104	163	132	171	144	153	1,626
Air Force	181	143	180	186	115	137	101	135	139	132	1,449
Energy	327	293	234	236	224	215	223	195	242	172	2,361
NASA	136	144	93	122	93	127	128	151	151	165	1,310
Health & Human Services	30	35	28	34	27	34	37	48	76	85	434
Agriculture	48	33	32	29	35	43	49	46	53	54	422
Other agencies	41	38	41	35	32	36	48	56	59	60	446
TOTAL	1,235	1,139	1,022	981	733	880	983	1,183	1,161	1,165	10,482

Source: U.S. Patent & Trademark Office

ORIGIN OF CHEMICAL LITERATURE: Russia is fifth largest producer

% of total papers[a]	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
U.S.	27.0%	27.1%	27.0%	27.7%	27.8%	27.4%	27.8%	27.9%	29.2%	27.4%	28.1%
Japan	10.6	10.4	12.1	11.5	11.7	11.5	11.8	12.1	12.5	13.2	13.3
Germany	7.3[b]	7.2[b]	7.4[b]	7.3[b]	7.2[b]	7.5[b]	7.4[b]	7.4[b]	7.3	7.4	7.5
U.K.	5.8	5.6	5.8	5.6	5.7	5.6	5.7	5.5	5.7	5.7	5.7
Russia[c]	—	—	—	—	—	—	—	—	—	2.0	5.4
France	4.1	4.0	4.3	4.3	4.2	4.3	4.2	4.2	4.2	4.4	4.7
China	2.1	2.3	2.6	3.1	3.3	3.5	3.7	4.5	4.0	4.7	4.3
Canada	2.7	2.8	2.9	3.1	3.0	3.1	3.0	3.0	3.0	3.0	3.2
India	3.0	3.2	3.0	3.0	2.3	3.1	2.8	2.9	2.7	2.8	2.6
Italy	2.5	2.5	2.4	2.4	1.7	2.4	2.3	2.3	2.4	2.6	2.6
Spain	0.9	1.0	1.2	1.3	1.4	1.4	1.4	1.5	1.4	1.6	1.7
Netherlands	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.6	1.6
Australia	1.3	1.3	1.4	1.8	1.3	1.3	1.2	1.2	1.2	1.4	1.4
Poland	1.8	1.7	1.7	1.3	1.7	1.7	1.6	1.5	1.5	1.4	1.4
Sweden	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.1	1.2	1.2
Switzerland	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.0	1.1	1.2	1.2
U.S.S.R.	17.0	16.8	14.9	13.0	12.7	13.0	12.7	12.5	11.1	6.5[d]	—
All others	10.4	10.5	9.6	10.9	11.0	10.4	10.6	9.9	10.1	11.9	14.1
TOTAL PAPERS (THOUSANDS)	371.4	380.7	380.1	384.1	386.5	389.7	397.2	394.9	453.6	430.2	448.7

a Source of journal literature abstracted in *Chemical Abstracts* based on first author's address. b Combined total for West Germany and East Germany. c Data for 1983–91 included in total for U.S.S.R. d Papers abstracted in 1992 that indicated U.S.S.R. as author's address. **Source:** Chemical Abstracts Service

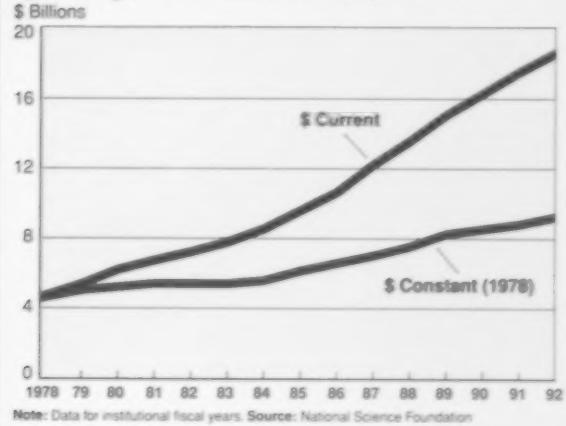
ABSTRACTS OF PAPERS IN *CHEMICAL ABSTRACTS*: Biochemistry's share jumps to 43%

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Change 1983–93
BIOCHEMISTRY	**38.3%**	**40.5%**	**40.5%**	**40.4%**	**40.5%**	**39.7%**	**39.2%**	**36.9%**	**39.5%**	**39.6%**	**43.0%**	**4.7%**
% of all biochemistry abstracts												
Mammalian hormones	12.9	12.4	12.3	12.5	12.2	12.0	12.0	11.5	12.2	11.7	10.7	–2.2
Mammalian biochemistry	11.1	11.3	11.1	10.8	11.1	10.8	10.7	10.5	12.0	12.3	13.4	2.3
Pharmacology	11.8	11.6	12.3	12.2	12.6	12.7	12.6	11.7	11.4	11.6	10.6	–1.2
Biochemical genetics	3.8	4.2	5.2	6.1	6.7	7.6	7.9	10.1	9.0	7.3	8.8	5.0
Toxicology	8.5	8.0	7.9	7.8	8.3	7.9	7.8	6.7	6.9	6.6	5.9	–2.6
Immunochemistry	4.2	4.8	5.3	6.1	5.8	5.8	6.3	6.8	6.2	7.4	7.8	3.6
Enzymes	6.1	5.8	5.6	5.6	5.4	6.1	6.1	6.1	5.9	5.6	6.1	0
Biochemical methods	4.9	4.9	4.9	5.0	4.8	5.1	5.1	4.7	5.2	5.0	4.5	–0.4
Plant biochemistry	5.9	6.2	5.5	5.2	5.3	5.0	4.6	5.1	5.1	4.7	4.7	–1.2
Microbial biochemistry	5.1	5.2	5.7	5.7	5.1	4.8	5.1	5.4	4.7	5.2	5.1	0
Food and feed chemistry	4.5	4.3	4.2	3.9	3.8	3.5	3.7	3.7	3.6	4.7	4.4	–0.1
Others	21.2	21.3	20.0	19.1	18.9	18.7	18.1	17.7	17.8	17.9	18.0	–3.2
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	—
PHYSICAL, INORGANIC, AND ANALYTICAL CHEMISTRY	**29.6%**	**28.8%**	**29.8%**	**29.8%**	**29.0%**	**28.8%**	**29.0%**	**30.3%**	**28.4%**	**27.7%**	**25.3%**	**–4.3%**
% of all physical, inorganic, and analytical chemistry abstracts												
Spectra	17.6	18.0	18.4	20.0	20.4	20.0	18.1	16.9	18.1	16.8	15.8	–1.8
Nuclear chemistry	22.5	22.2	21.8	19.9	19.5	17.8	19.4	17.1	16.3	17.4	19.8	–2.7
Electric phenomena	10.0	10.8	10.8	10.8	10.9	12.5	13.9	13.2	14.8	14.6	14.7	4.7
General physical chemistry	7.3	6.9	6.9	7.0	7.9	7.2	6.9	7.7	7.3	7.5	7.6	0.3
Analytical chemistry	6.2	6.3	6.1	6.8	5.9	5.7	5.1	7.9	6.4	6.4	6.0	0.2
Crystallography and liquid crystals	8.3	7.8	7.5	7.0	7.1	7.0	7.8	7.3	7.4	7.7	7.2	–1.1
Surface chemistry and colloids	4.3	4.5	4.9	4.7	5.0	5.8	5.7	6.0	6.3	5.9	6.0	1.7
Others	23.8	23.5	23.6	23.8	23.3	24.0	23.1	23.9	23.4	23.7	22.9	0.9
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	—
APPLIED CHEMISTRY AND CHEMICAL ENGINEERING	**19.4%**	**17.6%**	**18.4%**	**18.2%**	**18.0%**	**18.6%**	**18.1%**	**18.2%**	**18.9%**	**20.2%**	**20.0%**	**0.6%**
% of all applied chemistry and chemical engineering abstracts												
Metals and alloys	19.1	18.9	20.0	20.8	20.6	21.7	22.1	24.5	21.2	22.0	22.8	3.7
Water, wastes, and pollution	19.6	21.0	20.2	21.9	20.4	20.4	17.8	18.8	22.2	21.7	20.1	0.5
Ceramics	5.4	5.1	5.6	5.8	6.3	6.7	9.1	9.4	9.1	10.4	8.4	3.0
Fossil fuels, derivatives, and related products	10.3	10.1	10.1	9.0	9.6	8.8	8.7	8.0	8.8	7.8	6.8	–3.5
Unit operations and processes	7.5	7.0	7.5	7.1	9.0	8.0	10.3	9.2	8.3	9.7	10.1	2.6
Pharmaceuticals and pharmaceutical analysis	6.5	7.0	8.0	8.2	7.8	7.6	7.8	8.2	7.6	7.1	8.9	2.4
Mineralogical and geological chemistry	14.1	14.6	12.5	12.0	11.2	11.8	9.3	7.8	10.1	7.4	8.3	–5.8
Others	17.5	16.3	16.1	15.2	15.1	15.0	14.9	14.1	12.7	13.9	14.6	–2.9
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	—
ORGANIC CHEMISTRY	**7.3%**	**7.6%**	**6.4%**	**5.9%**	**6.9%**	**7.3%**	**7.8%**	**8.7%**	**7.6%**	**6.6%**	**5.7%**	**–1.6%**
% of all organic chemistry abstracts												
Physical organic chemistry	30.5	32.0	30.6	27.3	23.9	23.0	25.9	21.2	21.3	21.6	23.4	–7.1
Heterocyclic compounds	16.2	15.6	16.1	15.0	19.9	18.8	16.1	17.4	19.0	18.0	16.0	–0.2
Organometallic and organometalloidal compounds	16.3	17.1	16.2	18.3	16.1	15.7	18.4	20.4	16.6	17.0	19.0	2.7
Carbohydrates	5.8	5.7	5.7	7.8	5.6	8.1	6.5	7.4	8.5	9.3	8.4	2.6
Amino acids, peptides, and proteins	4.5	4.8	4.6	3.9	4.3	5.8	4.5	6.0	7.3	6.7	7.4	2.9
Aromatic compounds	7.1	6.3	6.3	7.3	7.7	7.2	6.9	7.1	6.8	6.4	6.3	–0.8
Biomolecules and their synthetic analogs	4.5	4.4	4.9	5.0	5.8	6.1	5.8	5.9	5.8	5.6	5.4	0.9
Others	15.1	14.1	15.6	15.4	16.7	15.3	15.9	14.6	14.7	15.4	14.1	–1.0
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	—
MACROMOLECULAR CHEMISTRY	**5.4%**	**5.5%**	**4.9%**	**5.7%**	**5.6%**	**5.6%**	**5.9%**	**5.9%**	**5.6%**	**5.9%**	**6.0%**	**0.6%**
% of all macromolecular chemistry abstracts												
Synthetic high polymers	34.4	34.0	34.1	34.1	35.2	34.8	34.4	38.6	39.5	35.8	35.2	0.8
Plastics manufacture and uses	24.4	24.2	25.3	23.8	23.6	23.7	25.1	23.3	25.8	27.6	29.6	5.4
Textiles	7.9	7.3	8.2	8.8	8.1	7.3	7.2	6.7	7.1	6.6	6.4	–1.5
Cellulose, lignin, paper, and other wood products	9.1	9.6	9.1	9.8	8.8	9.6	9.2	7.6	6.3	7.9	7.9	–1.2
Industrial organic chemicals, leather, fats, and waxes	4.8	4.8	4.4	4.6	5.6	6.8	8.1	8.4	5.6	6.0	6.0	1.2
Synthetic elastomers and natural rubber	7.5	7.3	6.8	6.7	7.2	6.7	5.6	4.8	5.6	5.8	4.9	–2.6
Coatings, inks, and related products	6.6	7.8	7.2	7.2	5.8	5.7	5.6	5.2	5.5	5.2	4.6	–2.0
Others	5.3	5.0	4.9	5.0	5.7	5.4	4.8	5.4	4.6	5.1	5.4	0.1
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	—

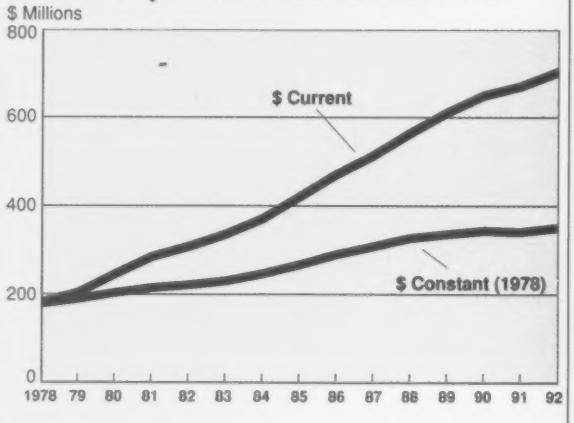
How to read this table: Using biochemistry as an example, in 1993 43.0% of all the papers abstracted by Chemical Abstracts Service are in the various subdisciplines of biochemistry; 10.7% of all abstracts in biochemistry, in turn, are in the subdiscipline of mammalian hormones, and so on. **Source:** Chemical Abstracts Service

Growth Of Academic R&D Spending Eases Off To 7% In 1992

In constant dollars, academic R&D spending has doubled since 1978 . . .



. . . and academic spending for work in chemistry increased 88% in real terms



Note: Data for institutional fiscal years. **Source:** National Science Foundation

CHARACTER OF ACADEMIC R&D SPENDING: Both basic and applied work grow slowly

$ Millions	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	% annual change 1991–92	% annual change 1982–92
Basic research	$4,878	$5,303	$5,732	$6,555	$ 7,491	$ 8,391	$ 8,892	$ 9,802	$10,680	$11,562	$12,468	8%	10%
Applied research and development	2,445	2,578	2,888	3,131	3,436	3,761	4,571	5,217	5,654	6,075	6,412	6	10
TOTAL	$7,323	$7,881	$8,620	$9,686	$10,927	$12,152	$13,463	$15,019	$16,334	$17,637	$18,880	7%	10%
ANNUAL CHANGE	7%	8%	9%	12%	13%	11%	11%	12%	9%	8%	7%		

Note: Data for institutional fiscal years. **Source:** "Survey of Scientific and Engineering Expenditures at Universities and Colleges," National Science Foundation

SOURCE OF ACADEMIC R&D FUNDS: Institutions themselves provide 19% of R&D money

$ Millions	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	% annual change 1991–92	% annual change 1982–92
Federal government	$4,768	$4,988	$5,430	$6,063	$ 6,710	$ 7,344	$ 8,192	$ 8,997	$ 9,637	$10,226	$11,087	8%	9%
Institutional funds	1,111	1,302	1,411	1,617	1,868	2,169	2,357	2,714	3,033	3,404	3,576	5	12
State and local governments	616	626	690	752	915	1,023	1,106	1,234	1,339	1,484	1,506	1	9
Industry	337	389	475	560	700	790	872	998	1,130	1,210	1,302	8	14
Other sources	491	576	614	694	734	826	936	1,076	1,195	1,313	1,409	7	11
TOTAL	$7,323	$7,881	$8,620	$9,686	$10,927	$12,152	$13,463	$15,019	$16,334	$17,637	$18,880	7%	10%

Note: Data for institutional fiscal years. **Source:** "Survey of Scientific and Engineering Expenditures at Universities and Colleges," National Science Foundation

FIELDS OF ACADEMIC R&D SPENDING: Chemistry growing more slowly than science overall

$ Millions	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	% annual change 1991–92	% annual change 1982–92
ALL SCIENCES	**$6,282**	**$6,760**	**$7,388**	**$8,268**	**$ 9,286**	**$10,260**	**$11,367**	**$12,621**	**$13,671**	**$14,730**	**$15,798**	**7%**	**10%**
Life sciences	4,017	4,305	4,711	5,279	5,890	6,528	7,257	8,082	8,748	9,497	10,228	8	10
Physical sciences	823	900	1,001	1,148	1,287	1,398	1,554	1,649	1,809	1,945	2,058	6	10
Physics	367	417	474	551	631	673	740	785	842	872	915	5	10
Chemistry	308	335	372	421	470	513	565	610	651	671	701	4	9
Environmental sciences	557	616	645	705	775	839	894	1,014	1,080	1,130	1,249	11	8
Psychology and social sciences	484	481	504	541	632	689	765	874	964	1,046	1,153	10	9
Computer sciences	149	187	224	281	321	372	409	472	514	554	556	0	14
Mathematical sciences	96	106	123	128	152	177	199	214	221	230	247	7	10
Others	156	165	180	186	229	257	289	316	335	328	307	–6	7
ENGINEERING	**1,041**	**1,121**	**1,232**	**1,418**	**1,641**	**1,892**	**2,096**	**2,398**	**2,663**	**2,907**	**3,082**	**6**	**11**
Chemical	84	91	102	116	132	148	163	194	219	244	262	7	12
TOTAL	**$7,323**	**$7,881**	**$8,620**	**$9,686**	**$10,927**	**$12,152**	**$13,463**	**$15,019**	**$16,334**	**$17,637**	**$18,880**	**7%**	**10%**
ANNUAL CHANGE	**7%**	**8%**	**9%**	**12%**	**13%**	**11%**	**11%**	**12%**	**9%**	**8%**	**7%**		

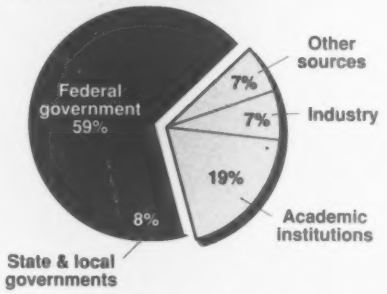
Note: Data for institutional fiscal years. **Source:** "Survey of Scientific and Engineering Expenditures at Universities and Colleges," National Science Foundation

FEDERALLY FINANCED R&D SPENDING AT UNIVERSITIES: Physical sciences get 13% of total

$ Millions	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	% annual change 1991–92	% annual change 1982–92
ALL SCIENCES	**$4,060**	**$4,250**	**$4,641**	**$5,197**	**$5,733**	**$6,230**	**$6,961**	**$7,614**	**$8,114**	**$ 8,592**	**$ 9,332**	**9%**	**9%**
Life sciences	2,502	2,586	2,830	3,188	3,493	3,836	4,326	4,783	5,077	5,407	5,893	9	9
Physical sciences	650	699	782	890	982	1,051	1,157	1,197	1,314	1,383	1,476	7	9
Physics	307	343	390	453	510	535	580	605	651	668	701	5	9
Chemistry	230	247	279	313	338	368	403	423	445	447	476	6	8
Environmental sciences	391	426	446	474	517	546	589	661	691	708	799	13	7
Psychology and social sciences	250	237	241	260	287	293	329	368	394	444	500	13	7
Computer sciences	107	139	163	196	233	257	289	322	340	369	377	2	13
Mathematical sciences	72	76	92	97	114	132	150	156	160	170	183	8	10
Others	88	87	87	92	107	115	121	127	138	111	104	–6	2
ENGINEERING	**704**	**733**	**789**	**867**	**978**	**1,113**	**1,230**	**1,383**	**1,524**	**1,635**	**1,755**	**7**	**10**
Chemical	50	53	60	65	73	77	86	101	111	118	126	7	10
TOTAL	**$4,764**	**$4,983**	**$5,430**	**$6,064**	**$6,711**	**$7,343**	**$8,191**	**$8,997**	**$9,638**	**$10,227**	**$11,087**	**8%**	**9%**
ANNUAL CHANGE	**4%**	**5%**	**9%**	**12%**	**11%**	**9%**	**12%**	**10%**	**7%**	**6%**	**8%**		

Note: Data for institutional fiscal years. **Source:** "Survey of Scientific and Engineering Expenditures at Universities and Colleges," National Science Foundation

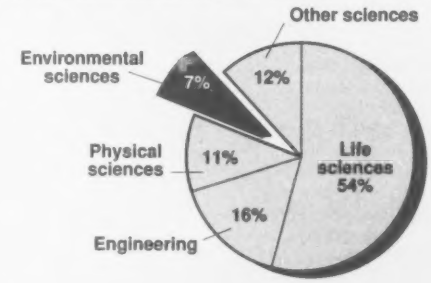
Government bodies supply 67% of academic R&D funds



1992 academic R&D expenditures = $18.9 billion

Source: National Science Foundation

Environmental sciences account for 7% of academic R&D efforts



1992 academic R&D expenditures = $18.9 billion

Source: National Science Foundation

SCHOOLS SPENDING MOST ON CHEMICAL R&D: Stanford, Maryland join top 10

Rank 1992	Rank 1991	$ Thousands	1987	1988	1989	1990	1991	1992 Total spending	1992 % federal funds	% annual change 1991–92	% annual change 1987–92
1	1	U of Texas, Austin	$ 11,420	$ 10,943	$ 11,484	$ 13,259	$ 16,513	$ 16,021	54%	–3%	7%
2	5	Harvard U	8,895	9,886	11,856	13,114	12,384	14,103	88	14	10
3	2	Massachusetts Inst. of Technology	11,471	13,287	15,031	17,109	16,426	13,999	89	–15	4
4	4	U of California, Berkeley	12,490	14,285	12,663	13,804	13,906	13,835	87	–1	2
5	3	California Inst. of Technology	10,870	9,931	9,235	10,667	13,931	12,647	87	–9	3
6	8	U of California, Los Angeles	10,099	9,519	9,855	11,217	10,519	12,137	89	15	4
7	10	Pennsylvania State U	6,072	7,739	8,616	9,148	9,635	11,719	59	22	14
8	12	Stanford U	8,916	10,547	10,098	9,693	8,882	10,846	78	22	4
9	6	Cornell U	8,397	10,472	10,217	10,042	10,825	10,550	84	–3	5
10	17	U of Maryland, College Park	9,258	8,545	9,732	10,977	8,415	9,991	47	19	2
		Total, first 10 institutions	$ 97,888	$105,154	$108,787	$119,030	$121,436	$125,848	76%	4%	5%
11	7	U of Pennsylvania	6,741	7,292	7,760	8,077	10,633	9,812	82	–8	8
12	13	U of Wisconsin, Madison	6,984	7,282	8,326	8,937	8,878	9,804	71	10	7
13	28	Georgia Inst. of Technology	4,889	5,989	5,380	5,215	6,796	9,656	56	42	15
14	9	U of Massachusetts[a]	7,589	5,280	2,988	9,245	9,684	9,583	56	–1	5
15	11	U of Illinois, Urbana-Champaign	9,035	8,647	9,208	9,230	9,457	9,439	72	0	1
16	14	U of California, San Diego	5,179	6,780	6,487	8,120	8,811	9,076	86	3	12
17	15	Purdue U	7,092	8,615	8,769	8,672	8,690	8,879	78	2	5
18	23	Indiana U	6,181	7,991	7,927	7,344	7,324	8,853	70	21	7
19	16	Princeton U	6,477	8,087	8,873	9,099	8,663	8,557	70	–1	6
20	25	Ohio State U	5,755	7,568	6,771	6,225	6,178	8,289	76	34	8
		Total, first 20 institutions	$163,810	$178,685	$181,276	$199,194	$206,550	$217,796	74%	5%	6%
21	20	Rutgers, State U of New Jersey	3,913	5,926	7,905	7,812	7,818	8,263	73	6	16
22	22	Yale U	5,538	6,869	5,915	6,037	7,587	7,974	85	5	8
23	18	Texas A&M U	7,462	8,785	9,808	8,046	8,201	7,903	53	–4	1
24	30	Wayne State U	3,278	4,582	5,557	5,455	6,458	7,756	30	20	19
25	21	Northwestern U	6,095	6,644	7,661	7,219	7,781	7,651	70	–2	5
26	33	U of Notre Dame	5,550	7,004	6,660	6,348	6,170	7,274	90	18	6
27	24	Virginia Polytechnic Inst. & State U	4,190	4,735	5,155	6,321	7,157	7,178	41	0	11
28	27	U of Colorado	5,118	5,637	6,587	6,041	6,863	6,895	80	0	6
29	19	Arizona State U	3,586	4,306	5,260	7,967	8,054	6,755	65	–16	14
30	35	U of Utah	4,846	4,600	5,653	5,089	6,101	6,697	78	10	7
		Total, first 30 institutions	$213,386	$237,773	$247,437	$265,529	$278,740	$292,142	72%	5%	6%
31	38	U of Washington	3,655	4,338	5,192	6,057	5,789	6,538	61	13	12
32	43	U of Southern California	3,311	3,832	4,374	5,667	5,510	6,337	92	15	14
33	40	U of North Carolina, Chapel Hill	3,471	4,476	5,171	5,310	5,613	6,306	84	12	13
34	41	U of California, Irvine	3,541	4,534	3,910	4,835	5,546	6,237	91	12	12
35	32	U of Oregon	4,462	5,550	5,501	6,760	6,211	6,076	73	–2	6
36	42	U of Arizona	3,441	3,934	4,532	5,034	5,531	6,030	66	9	12
37	31	Columbia U, main division	6,715	4,605[b]	4,721[b]	5,858	6,305	5,985	97	–5	–2
38	50	U of Michigan	3,276	3,879	3,788	3,735	5,031	5,970	69	19	13
39	34	U of Minnesota	5,426	5,232	5,863	6,663	6,160	5,952	85	–3	2
40	51	U of Pittsburgh	5,105	5,598	5,736	5,832	4,826	5,876	84	22	3
		Total, first 40 institutions	$255,789	$283,751	$296,225	$321,280	$335,262	$353,449	74%	5%	7%
41	36	U of Rochester	3,545	4,437	4,762	6,537	6,067	5,871	92	–3	11
42	46	U of Florida	5,690	5,030	5,061	5,396	5,153	5,847	50	13	1
43	58	Emory U	2,333	2,770	3,581	4,228	4,269	5,646	84	32	19
44	29	Johns Hopkins U	5,593	5,211	5,152	5,435	6,564	5,356	93	–18	–1
45	49	Georgetown U	2,735	2,878	3,904	3,860	5,039	5,350	77	6	14
46	48	U of Kansas	2,803	3,845	4,952	5,450	5,059	5,254	36	4	13
47	47	U of Virginia	4,169	4,153	5,096	5,281	5,089	5,225	80	3	5
48	63	Rensselaer Polytechnic Inst.	2,511	3,737	4,156	4,551	3,811	5,214	48	37	16
49	61	U of Alabama, Huntsville	1,396	1,493	2,972	4,317	4,021	5,157	89	28	30
50	44	U of Georgia	2,239	3,531	4,091	4,453	5,508	5,042	44	–8	18
		Total, first 50 institutions	$288,803	$320,836	$339,952	$370,788	$385,842	$407,411	73%	6%	7%
		NATIONAL TOTAL	$513,116	$565,318	$609,534	$650,926	$670,963	$701,216	68%	5%	6%

Note: Data for institutional fiscal years. A number of institutions have developed or are developing new computer systems and methodologies that enable them to report more accurately the total cost of science and engineering research. Comparing 1992 data with those reported in earlier years may not be appropriate in some areas. **a** 1992 figures are for Amherst campus only. **b** Estimated. **Source:** "Survey of Scientific and Engineering Expenditures at Universities and Colleges," National Science Foundation

SCHOOLS WITH MOST FEDERAL SUPPORT FOR CHEMICAL R&D: Harvard moves into first place

Rank 1992	Rank 1991	$ Thousands	1987	1988	1989	1990	1991	1992	% annual change 1991–92	% annual change 1987–92
1	4	Harvard U	$ 8,309	$ 9,272	$ 10,594	$ 11,585	$ 10,972	$ 12,387	13%	8%
2	1	Massachusetts Inst. of Technology	10,656	11,987	13,333	15,129	14,549	12,384	–15	3
3	2	U of California, Berkeley	11,160	12,998	11,540	12,219	12,210	12,008	–2	1
4	3	California Inst. of Technology	9,922	8,769	7,459	8,629	12,006	10,970	–9	2
5	5	U of California, Los Angeles	9,414	8,885	9,024	10,216	9,327	10,841	16	3
6	6	Cornell U	6,753	8,269	7,458	7,211	8,365	8,852	6	6
7	9	U of Texas, Austin	6,405	6,443	6,120	6,723	7,881	8,700	10	6
8	10	Stanford U	7,918	9,423	8,878	8,839	7,452	8,414	13	1
9	7	U of Pennsylvania	5,653	6,337	7,046	7,330	8,168	8,059	–1	7
10	8	U of California, San Diego	4,599	6,161	5,757	7,422	7,949	7,799	–2	11
		Total, first 10 institutions	$ 80,789	$ 88,544	$ 87,209	$ 95,303	$ 98,879	$100,414	2%	4%
11	12	Pennsylvania State U	4,915	5,957	6,515	6,429	6,630	6,972	5	7
12	18	U of Wisconsin, Madison	4,718	4,939	5,505	6,041	5,739	6,929	21	8
13	11	Purdue U	5,978	7,120	7,102	6,893	7,086	6,909	–2	3
14	14	U of Illinois, Urbana-Champaign	6,306	6,193	6,566	6,563	6,484	6,804	5	2
15	13	Yale U	4,909	5,927	5,011	5,256	6,521	6,752	4	7
16	20	U of Notre Dame	5,158	6,557	5,983	5,667	5,599	6,582	18	5
17	31	Ohio State U	4,517	5,437	4,445	4,152	4,844	6,300	30	7
18	28	Indiana U	4,923	6,354	6,127	5,225	5,173	6,157	19	5
19	24	Rutgers, State U of New Jersey	2,525	3,442	6,572	6,016	5,426	5,993	10	19
20	17	Princeton U	5,064	5,812	5,681	6,104	5,794	5,952	3	3
		Total, first 20 institutions	$129,802	$146,282	$146,716	$153,649	$158,175	$165,764	5%	5%
21	23	U of Southern California	2,903	3,568	3,986	5,358	5,427	5,826	7	15
22	16	Columbia U, main division	6,625	4,246[a]	4,344[a]	5,540	5,944	5,785	–3	–3
23	27	U of California, Irvine	3,386	4,376	3,685	4,437	5,226	5,682	9	11
24	26	U of Massachusetts[b]	5,036	3,296	1,326	5,494	5,300	5,522	4	2
25	25	U of Colorado	4,402	4,603	5,418	5,218	5,422	5,494	1	5
26	41	Georgia Inst. of Technology	2,565	3,574	3,020	2,941	3,902	5,426	39	16
27	19	U of Rochester	3,275	3,936	4,327	5,998	5,650	5,402	–4	11
28	21	Northwestern U	4,641	4,955	5,577	5,465	5,462	5,372	–2	3
29	30	U of North Carolina, Chapel Hill	3,153	4,193	4,534	4,651	4,980	5,281	6	11
30	33	U of Utah	4,194	3,614	3,872	3,746	4,688	5,225	11	4
		Total, first 30 institutions	$169,982	$186,643	$186,805	$202,497	$210,176	$220,779	5%	5%
31	29	U of Minnesota	4,395	4,156	5,054	5,857	5,004	5,062	1	3
32	15	Johns Hopkins U	5,116	4,830	4,824	4,994	6,044	4,992	–17	0
33	39	U of Pittsburgh	4,028	4,803	4,558	4,721	3,958	4,959	25	4
34	47	Emory U	2,093	2,362	2,719	3,509	3,290	4,752	44	18
35	35	U of Maryland, College Park	4,073	3,793	3,844	4,774	4,566	4,687	3	3
36	44	U of Alabama, Huntsville	na	1,059	2,414	3,880	3,610	4,591	27	na
37	43	Arizona State U	2,317	2,813	3,172	3,626	3,696	4,414	19	14
38	32	U of Oregon	3,579	4,519	4,435	5,182	4,751	4,411	–7	4
39	34	U of Chicago	6,499	7,235	8,621	8,524	4,597	4,235	–8	–8
40	37	U of Virginia	3,281	3,419	4,165	4,038	4,072	4,191	3	5
		Total, first 40 institutions	$205,363	$225,632	$230,611	$251,602	$253,764	$267,073	5%	5%
41	36	Texas A&M U	4,019	4,945	4,408	3,716	4,395	4,187	–5	1
42	46	U of Michigan	2,615	3,310	3,022	2,786	3,423	4,138	21	10
43	38	Georgetown U	2,155	2,148	3,113	3,088	3,963	4,110	4	14
44	42	U of Washington	2,287	2,904	3,756	4,139	3,796	4,011	6	12
45	45	U of Arizona	2,499	2,885	3,044	3,210	3,580	3,969	11	10
46	49	U of California, Santa Barbara	3,526	3,196	3,242	3,869	3,201	3,835	20	2
47	50	Colorado State U	3,273	4,280	3,457	2,998	3,146	3,794	21	3
48	48	Rockefeller U	3,247	3,082	3,713	4,331	3,289	3,295	0	0
49	60	U of Tennessee system	1,737	2,541	2,985	2,441	2,272	3,171	40	13
50	40	State U of New York, Stony Brook	2,930	3,460	3,610	3,816	3,940	3,129	–21	1
		Total, first 50 institutions	$233,651	$258,383	$264,961	$285,996	$288,769	$304,712	6%	5%
		NATIONAL TOTAL	$367,765	$402,876	$422,609	$444,899	$447,306	$476,266	6%	5%

Note: Data for institutional fiscal years. A number of institutions have developed or are developing new computer systems and methodologies that enable them to report more accurately the total cost of science and engineering research. Comparing 1992 data with those reported in earlier years may not be appropriate in some areas. a Estimated. b 1992 figures are for Amherst campus only. **na** = not available. **Source:** "Survey of Scientific and Engineering Expenditures at Universities and Colleges," National Science Foundation

SCHOOLS SPENDING MOST ON CHEMICAL ENGINEERING R&D: Top five spend 20% of total

Rank 1992	Rank 1991	$ Thousands	1989	1990	1991	1992 Total spending	1992 % federal funds	% annual change 1991–92	% annual change 1989–92
1	1	Massachusetts Inst. of Technology	$ 13,493	$ 13,456	$ 16,972	$ 13,007	64%	–23%	–1%
2	3	Texas A&M U	4,159	6,017	9,974	12,352	16	24	44
3	2	U of Tennessee system	1,115	935	10,010	9,518	89	–5	104
4	5	U of Minnesota	8,403	7,817	8,540	9,416	66	10	4
5	6	Case Western Reserve U	3,378	3,665[a]	8,145	9,344	52	15	40
6	4	U of Texas, Austin	6,109	6,025	9,387	7,816	46	–17	9
7	31	U of Oklahoma	2,189	1,594	2,160	7,275	33	237	49
8	7	North Carolina State U, Raleigh	3,304	4,421	6,081	5,804	36	–5	21
9	10	U of Delaware	3,147	3,826	4,899	5,175	27	6	18
10	8	Johns Hopkins U	4,842	4,580	5,103	5,158	90	1	2
11	9	U of Wisconsin, Madison	3,839	4,363	4,903	5,054	46	3	10
12	11	Auburn U	2,217	3,259	3,619	3,995	17	10	22
13	54	Colorado School of Mines	na	738	1,399	3,794	46	171	na
14	na	Brigham Young U	2,867	na	na	3,774	72	na	10
15	18	U of California, Santa Barbara	1,880	2,280	3,025	3,701	80	22	25
16	14	Columbia U, main division	5,308	4,262	3,230	3,673	41	14	–12
17	16	Stanford U	2,939	3,130[b]	3,151	3,525	73	12	6
18	13	Rensselaer Polytechnic Inst.	1,477	2,017	3,297	3,509	48	6	33
19	25	U of Houston	2,015	2,870	2,496	3,360	40	35	19
20	10	Louisiana State U system	2,396	2,714	3,006	3,261	25	8	11
21	22	Georgia Inst. of Technology	2,124	5,382	2,710	3,197	56	18	15
22	na	U of Dayton	12	80	0	3,196	81	na	543
23	20	Lehigh U	2,742	3,067	2,883	3,114	13	8	4
24	15	Princeton U	2,367	2,981	3,207	3,033	42	–5	9
25	29	Oklahoma State U	370	4,028	2,261	3,011	62	33	101
		Total, first 25 institutions	**$ 82,692**	**$ 93,507**	**$120,458**	**$138,062**	**51%**	**15%**	**19%**
		NATIONAL TOTAL	**$185,087**	**$206,172**	**$238,553**	**$262,195**	**56%**	**10%**	**12%**

Note: Data for institutional fiscal years. A number of institutions have developed or are developing new computer systems and methodologies that enable them to report more accurately the total cost of science and engineering research. Comparing 1992 data with those reported in earlier years may not be appropriate in some areas. a Estimated. b Imputed. Institution was not among top 100 spenders of engineering funds. na = not available. **Source:** "Survey of Scientific and Engineering Expenditures at Universities and Colleges," National Science Foundation

SCHOOLS WITH MOST FEDERAL SUPPORT FOR CHEMICAL ENGINEERING R&D: MIT slips

Rank 1992	Rank 1991	$ Thousands	1989	1990	1991	1992	% annual change 1991–92	% annual change 1989–92
1	2	U of Tennessee system	$ 178	$ 303	$ 8,522	$ 8,434	–1%	262%
2	1	Massachusetts Inst. of Technology	9,359	9,279	9,605	8,289	–14	–4
3	3	U of Minnesota	5,279	5,249	5,562	6,194	11	5
4	5	Case Western Reserve U	2,104	2,004	4,295	4,827	12	32
5	4	Johns Hopkins U	4,352	4,171	4,501	4,650	3	2
6	6	U of Texas, Austin	2,253	2,388	3,406	3,610	6	17
7	12	U of California, Santa Barbara	1,580	1,764	2,315	2,958	28	23
8	–	U of Dayton	10	67	0	2,852	na	558
9	10	Brigham Young U	2,290	2,242	2,336	2,736	17	6
10	11	New Mexico State U	1,482	35	2,322	2,693	16	22
11	7	Stanford U	2,564	2,701[a]	2,484	2,557	3	0
12	50	U of Oklahoma	505	1,594	633	2,393	278	68
13	8	U of Wisconsin, Madison	2,096	2,407	2,463	2,338	–5	na
14	14	California Inst. of Technology	1,635	1,477	1,911	2,205	15	10
15	19	U of Alabama, Huntsville	1,019	1,836	1,461	2,110	44	27
16	9	North Carolina State U, Raleigh	861	1,764	2,422	2,071	–14	34
17	15	Texas A&M U	706	922	1,703	1,971	16	41
18	16	Oklahoma State U	84	2,660	1,645	1,877	14	182
19	20	U of Michigan	1,482	1,686	1,447	1,860	29	8
20	17	Georgia Inst. of Technology	1,192	3,035	1,556	1,796	15	15
21	54	Colorado School of Mines	na	321	1,556	1,727	11	na
22	13	Cornell U	1,250	1,340	2,084	1,720	–17	11
23	18	Rensselaer Polytechnic Inst.	606	971	1,358	1,681	24	41
24	60	Columbia U, main division	3,059	2,265	424	1,520	258	–21
25	40	U of Pittsburgh	794	760	937	1,479	58	23
		Total, first 25 institutions	**$46,740**	**$53,241**	**$ 66,948**	**$ 76,548**	**14%**	**18%**
		NATIONAL TOTAL	**$92,947**	**$99,937**	**$114,310**	**$126,473**	**11%**	**11%**

Note: Data for institutional fiscal years. A number of institutions have developed or are developing new computer systems and methodologies that enable them to report more accurately the total cost of science and engineering research. Comparing 1992 data with those reported in earlier years may not be appropriate in some areas. a Imputed. Institution was not among top 100 recipients of engineering funds. na = not available. **Source:** "Survey of Scientific and Engineering Expenditures at Universities and Colleges," National Science Foundation

TOP 10 UNIVERSITIES IN R&D SPENDING: Top 10 spend 20% of all R&D funds

Rank 1992	Rank 1991	$ Millions, 1992	Physical sciences	Chemistry[a]	Engineering	Environmental sciences	Life sciences	Math & computer sciences	Other sciences	Total
1	1	Johns Hopkins U	$ 130.1	$ 5.4	$ 225.4	$ 41.1	$ 226.2	$ 86.8	$ 25.9	$ 735.5
2	2	U of Michigan	23.9	6.0	64.9	20.5	196.0	24.5	63.4	393.2
3	6	Stanford U	75.7	10.8	107.5	6.9	155.7	13.3	8.9	368.0
4	4	U of Wisconsin, Madison	35.2	9.8	46.3	21.7	202.2	8.4	38.8	352.6
5	5	Massachusetts Inst. of Technology	95.9	14.0	141.0	13.1	38.1	16.4	20.0	324.5
6	3	U of Minnesota	16.2	6.0	26.1	11.8	224.2	18.4	20.3	317.0
7	9	U of Washington	17.6	6.5	18.4	59.4	192.5	9.8	15.8	313.5
8	8	Texas A&M U	16.9	7.9	77.5	65.7	123.0	4.7	17.5	305.3
9	7	Cornell U	44.6	10.6	44.0	5.1	164.0	27.2	14.5	299.4
10	10	U of California, San Francisco	0	0	0	0	295.8	0	0	295.8
		TOTAL, FIRST 10 INSTITUTIONS	$ 456.1	$ 77.0	$ 751.1	$ 245.3	$ 1,817.7	$209.5	$ 225.1	$ 3,704.8
		TOTAL, ALL INSTITUTIONS	$2,057.8	$701.2	$3,082.3	$1,248.8	$10,227.8	$802.7	$1,460.3	$18,879.7

Note: Data for institutional fiscal years. a Included in physical sciences. **Source:** "Survey of Scientific and Engineering Expenditures at Universities and Colleges," National Science Foundation

TOP 10 UNIVERSITY R&D CENTERS: About 40% of their effort goes to physical sciences

Rank 1992	Rank 1991	$ Millions, 1992	Physical sciences	Engineering	Math & computer sciences	Environmental sciences	Life sciences	Other sciences	Total
1	2	Jet Propulsion Lab	$ 92.6	$ 443.0	$516.1	$ 85.4	$ 0	$ 0	$1,137.1
2	1	Lawrence Livermore National Lab	388.6	459.0	143.3	31.9	32.9	0	1,055.7
3	3	Los Alamos National Lab	421.6	367.0	94.0	7.1	66.7	54.6	1,011.0
4	4	Argonne National Lab	119.5	205.9	6.9	90.4	17.9	0	440.6
5	5	Lincoln Lab	69.5	254.8	37.7	2.3	0	0	364.3
6	6	Brookhaven National Lab	210.7	48.0	1.3	11.2	25.7	1.3	298.2
7	7	Lawrence Berkeley Lab	164.6	10.5	3.1	13.7	39.7	7.8	239.4
8	8	Fermi National Accelerator Lab	197.7	0	0	0	0	0	197.7
9	9	Stanford Linear Accelerator Center	117.7	0	0	0	0	0	117.7
10	10	Plasma Physics Lab	110.2	0	0	0	0	0	110.2
		TOTAL, FIRST 10 INSTITUTIONS	$1,892.7	$1,788.2	$802.4	$242.0	$182.9	$63.7	$4,971.9
		TOTAL, ALL INSTITUTIONS	$2,017.1	$1,797.2	$838.2	$339.4	$191.2	$65.5	$5,248.6

Note: Data for university-administered, federally funded R&D centers. **Source:** "Survey of Scientific and Engineering Expenditures at Universities and Colleges," National Science Foundation

UNIVERSITY SPENDING FOR RESEARCH EQUIPMENT: Chemistry accounts for 7% of total

	1985		1991		1992		% annual change 1991–92		% annual change 1985–92	
$ Millions	Total	Federal funds	Total	Federal funds	Total	Federal funds	Total	Federal funds	Total	Federal funds
ALL SCIENCES	$547.0	$340.6	$ 792.7	$472.9	$ 813.1	$489.0	3%	3%	6%	5%
Life sciences	282.5	157.0	411.0	217.9	430.6	228.7	5	5	6	6
Physical sciences	141.8	113.2	190.6	139.5	200.0	151.6	5	9	5	4
Physics	71.2	60.2	85.4	66.7	91.0	73.0	7	9	4	3
Chemistry	53.9	41.4	70.3	47.5	71.9	50.8	2	7	4	3
Environmental sciences	47.8	32.4	70.6	43.6	78.6	52.0	11	19	7	7
Mathematical and computer sciences	41.5	21.0	69.9	50.2	55.6	36.2	–20	–28	4	8
Others	33.4	17.0	50.6	21.7	48.3	20.5	–5	–6	5	3
ENGINEERING	124.4	78.3	233.9	134.6	238.9	126.1	2	–6	10	7
Chemical	11.4	6.7	20.0	9.8	20.3	10.1	2	3	9	6
TOTAL	$671.4	$418.9	$1,026.6	$607.5	$1,052.0	$615.1	2%	1%	7%	6%

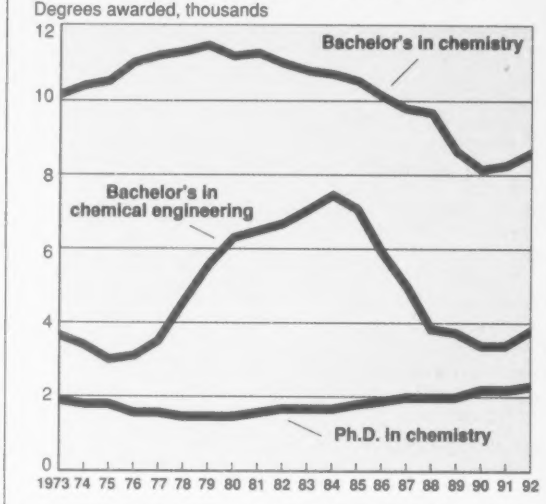
Note: Data for institutional fiscal years. **Source:** "Survey of Scientific and Engineering Expenditures at Universities and Colleges," National Science Foundation

CHEMICAL DEGREES: Number of bachelor's degrees in chemical engineering up 9%

Academic year	Degrees awarded in chemistry			Degrees awarded in chemical engineering		
	Bachelor's	Master's	Ph.D.	Bachelor's	Master's	Ph.D.
1973	10,125	2,225	1,882	3,578	1,051	397
1974	10,438	2,125	1,828	3,399	1,044	400
1975	10,549	1,986	1,822	3,070	990	346
1976	11,022	1,783	1,621	3,140	1,031	308
1977	11,215	1,767	1,563	3,524	1,086	291
1978	11,315	1,886	1,521	4,569	1,235	259
1979	11,509	1,757	1,516	5,588	1,149	304
1980	11,232	1,723	1,545	6,320	1,270	284
1981	11,347	1,654	1,622	6,527	1,267	300
1982	11,025	1,618	1,722	6,740	1,285	311
1983	10,796	1,622	1,746	7,185	1,368	319
1984	10,704	1,667	1,744	7,475	1,514	330
1985	10,482	1,719	1,789	7,146	1,544	418
1986	10,116	1,754	1,908	5,877	1,361	446
1987	9,661	1,738	1,976	4,983	1,184	497
1988	9,052	1,708	1,995	3,917	1,088	579
1989	8,625	1,774	2,037	3,683	1,093	602
1990	8,132	1,682	2,183	3,430	1,035	562
1991	8,321	1,165	2,238	3,444	903	611
1992	8,641	1,780	2,280	3,754	956	590

Note: Data collected from degree-granting institutions.
Source: National Center for Education Statistics

Chemistry Ph.D. degrees creep up 2%



Note: Academic years. **Source:** National Center for Education Statistics

GRADUATE SCIENCE STUDENTS: Engineering attracts three times as many as physical sciences

Thousands	1982	1983	1984[a]	1985[a]	1986[a]	1987[a]	1988	1989	1990	1991	1992	% annual change 1991–92	% annual change 1982–92
ALL SCIENCES	**255.9**	**257.3**	**258.1**	**263.1**	**266.6**	**269.8**	**272.8**	**279.3**	**290.3**	**300.3**	**313.5**	**4%**	**2%**
Psychology and social sciences	117.0	113.0	110.9	111.7	111.8	114.4	115.9	120.3	126.7	132.8	139.6	5	2
Mathematical and computer sciences	37.0	41.0	43.3	47.2	49.2	50.4	51.2	51.6	54.1	54.8	56.8	4	4
Biological sciences	46.1	45.8	45.9	46.2	46.9	46.9	47.7	49.0	50.1	51.9	54.4	5	2
Biochemistry	4.1	4.2	4.5	4.7	4.9	4.8	4.9	5.1	5.1	5.2	5.4	4	3
Physical sciences	28.2	29.5	30.1	31.0	32.2	32.7	33.0	33.6	34.1	34.8	35.5	2	2
Chemistry	17.0	17.8	17.8	18.3	18.7	18.8	18.6	18.8	19.1	19.4	19.9	3	2
Physics	10.3	10.8	11.3	11.7	12.4	12.8	13.3	13.7	13.9	14.1	14.3	1	3
Earth, atmospheric, and ocean sciences	15.2	15.6	15.7	15.6	15.2	14.5	14.1	13.8	14.2	14.7	15.6	6	0
Agricultural sciences	12.4	12.4	12.2	11.4	11.3	10.9	10.9	11.0	11.1	11.3	11.6	3	−1
ALL ENGINEERING	**83.9**	**91.1**	**92.8**	**96.2**	**102.1**	**104.1**	**103.1**	**104.2**	**107.7**	**113.3**	**118.0**	**4**	**3**
Chemical	7.2	7.6	7.4	7.2	7.0	7.1	6.6	6.5	6.7	7.1	7.4	4	0
Metallurgical and materials	3.1	3.4	3.7	3.9	4.2	4.4	4.3	4.6	4.9	5.2	5.5	6	6
TOTAL	**339.8**	**348.4**	**350.9**	**359.3**	**368.7**	**373.9**	**375.9**	**383.5**	**398.0**	**413.6**	**431.5**	**4%**	**2%**
ANNUAL CHANGE	**2%**	**3%**	**1%**	**2%**	**3%**	**1%**	**1%**	**2%**	**4%**	**4%**	**4%**		

Note: Data for all institutions, includes full- and part-time graduate students. a Includes estimated data for master's-granting institutions, which were surveyed on a sample basis from 1984 through 1987. **Source:** "Survey of Graduate Students and Postdoctorates in Science and Engineering," National Science Foundation

FOREIGN GRADUATE STUDENTS: Total drops to 25% of all grad students

	1987[a]		1988		1989		1990		1991		1992		% annual change	
	Thousands	% of total	Thousands	% of total	Thousands	% of total	Thousands	% of total	Thousands	% of total	Thousands	% of total	1991–92	1987–92
ALL SCIENCES	**48.07**	**26%**	**50.97**	**27%**	**53.20**	**28%**	**56.16**	**29%**	**57.86**	**28%**	**58.54**	**27%**	**1%**	**4%**
Psychology and social sciences	13.47	19	14.19	20	14.12	19	14.58	18	14.87	18	14.91	17	0	2
Mathematical and computer sciences	11.96	47	12.48	44	12.97	44	13.89	46	14.05	45	14.37	45	2	4
Physical sciences	10.03	35	10.48	37	11.14	38	11.69	40	11.90	40	11.93	39	0	4
Chemistry	4.94	30	5.32	33	5.72	35	6.14	37	6.35	38	6.30	37	–1	5
Physics	4.89	43	4.96	43	5.23	43	5.33	44	5.30	43	5.37	42	1	2
Biological sciences	8.01	21	9.00	23	10.01	25	10.68	26	11.60	27	11.82	27	2	8
Biochemistry	1.21	26	1.33	29	1.51	31	1.63	34	1.72	35	1.68	33	–2	7
Agricultural sciences	2.63	33	2.64	29	2.63	30	2.86	32	2.86	31	2.83	30	–1	1
Earth, atmospheric, and ocean sciences	1.97	19	2.18	21	2.33	23	2.46	24	2.60	25	2.69	24	3	6
ALL ENGINEERING	**28.04**	**45**	**29.54**	**47**	**30.33**	**47**	**31.53**	**48**	**33.69**	**48**	**34.25**	**46**	**2**	**4**
Chemical	2.31	41	2.39	45	2.61	49	2.76	51	2.98	51	2.93	49	–2	5
Metallurgical and materials	1.61	47	1.66	48	1.83	49	1.95	50	1.99	49	2.00	47	1	4
TOTAL	**76.11**	**31%**	**80.51**	**32%**	**83.53**	**32%**	**87.69**	**33%**	**91.57**	**33%**	**92.79**	**25%**	**1%**	**4%**
ANNUAL CHANGE	**5%**		**6%**		**4%**		**5%**		**4%**		**1%**			

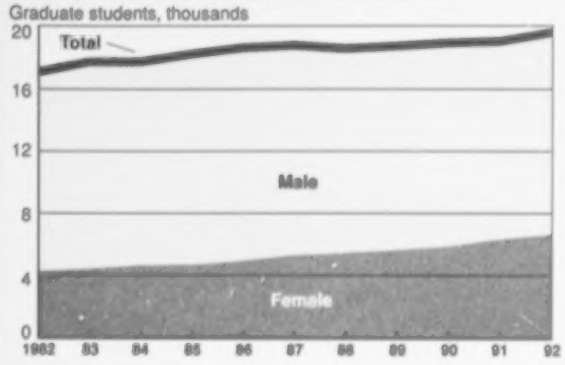
Note: The percent of total is the percent of all full-time graduate students in each area who are not U.S. citizens. a Includes estimated data for master's-granting institutions, which were surveyed on a sample basis in 1987. **Source:** "Survey of Graduate Students and Postdoctorates in Science and Engineering," National Science Foundation

POSTDOCTORAL APPOINTEES: Nearly one fourth work in chemistry or biochemistry

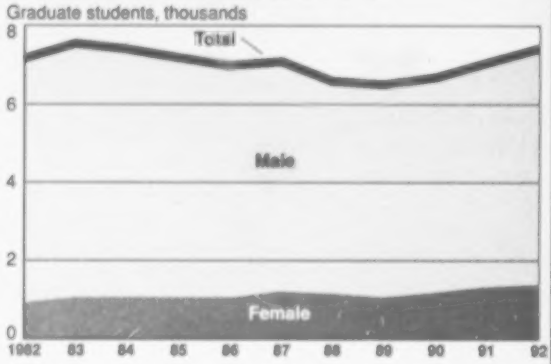
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	% annual change 1991–92	% annual change 1982–92
ALL SCIENCES	**13,694**	**14,556**	**14,974**	**15,519**	**16,449**	**17,327**	**18,004**	**18,970**	**19,873**	**20,660**	**21,677**	**5%**	**5%**
Biological sciences	7,756	8,355	8,707	9,136	9,701	10,364	10,686	11,449	11,963	12,550	13,287	6	6
Biochemistry	1,684	1,748	1,783	1,858	1,985	2,113	2,078	2,216	2,174	2,123	2,161	2	3
Physical sciences	4,281	4,444	4,386	4,495	4,808	4,941	5,178	5,348	5,557	5,678	5,772	2	3
Chemistry	2,805	2,973	2,906	2,995	3,149	3,234	3,420	3,456	3,629	3,647	3,573	–2	2
Physics	1,326	1,350	1,320	1,320	1,494	1,548	1,578	1,677	1,716	1,798	1,954	9	4
Psychology and social sciences	803	783	752	846	841	834	816	901	899	879	928	6	1
Earth, atmospheric, and ocean sciences	335	415	488	375	417	420	499	459	607	645	709	10	8
Agricultural sciences	279	307	375	373	409	441	454	512	529	575	634	10	9
Mathematical and computer sciences	240	252	266	294	273	327	371	301	318	333	350	5	4
ALL ENGINEERING	**978**	**1,101**	**1,194**	**1,353**	**1,398**	**1,443**	**1,684**	**1,908**	**1,940**	**2,255**	**2,344**	**4**	**9**
Chemical	174	198	245	273	295	310	423	466	551	578	554	–4	12
Metallurgical and materials	166	204	168	245	250	283	325	323	365	394	458	16	11
TOTAL	**14,672**	**15,657**	**16,168**	**16,872**	**17,847**	**18,770**	**19,688**	**20,878**	**21,813**	**22,915**	**24,024**	**5%**	**5%**
ANNUAL CHANGE	**–1%**	**7%**	**3%**	**4%**	**6%**	**5%**	**5%**	**6%**	**4%**	**5%**	**5%**		

Note: Doctorate-granting institutions. **Source:** "Survey of Graduate Students and Postdoctorates in Science and Engineering," National Science Foundation

In chemistry, women account for nearly one third of graduate students . . .



. . . in chemical engineering, they account for less than one fifth



Source: National Science Foundation

CHEMICAL DOCTORATE DEGREES: U.S. citizens' share falls to 59% from 76% in 1982

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	% annual change 1991–92	% annual change 1982–92
U.S. CITIZENS	**1,285**	**1,355**	**1,332**	**1,345**	**1,320**	**1,381**	**1,377**	**1,298**	**1,398**	**1,350**	**1,320**	**–2%**	**0%**
By sex													
Male	1,076	1,121	1,083	1,084	1,044	1,085	1,072	956	1,046	1,014	964	–15	–1
Female	209	234	249	261	276	296	305	342	352	336	356	6	5
By ethnic group													
White	1,191	1,248	1,189	1,219	1,182	1,243	1,235	1,167	1,249	1,201	1,184	–1	0
Asian	35	39	50	57	56	49	48	42	54	62	63	2	6
Hispanic	15	19	26	14	24	40	43	40	50	39	34	–13	9
Black	10	11	18	19	13	11	17	20	14	18	13	–28	3
Native American	nr	3	3	2	5	6	5	5	3	9	6	–33	—
Unknown	34	35	46	34	40	32	29	24	28	21	20	–5	–5
NON-U.S. CITIZENS	**348**	**352**	**381**	**417**	**486**	**490**	**516**	**546**	**629**	**799**	**834**	**4**	**9**
By sex													
Male	293	295	319	335	381	400	417	417	489	625	618	–1	8
Female	55	57	62	82	105	90	99	129	140	174	216	18	14
By ethnic group													
Asian	236	224	255	257	315	326	365	416	463	597	631	6	10
White	75	80	67	92	94	101	96	78	97	125	120	–4	5
Hispanic	9	16	26	28	23	24	22	18	24	27	28	4	12
Black	16	16	24	23	21	16	16	18	14	25	24	–4	4
Unknown	12	16	9	17	33	23	17	16	31	25	21	–16	6
CITIZENSHIP UNKNOWN	**47**	**52**	**52**	**74**	**97**	**104**	**122**	**126**	**73**	**44**	**68**	**55%**	**4%**
TOTAL	**1,680**	**1,759**	**1,765**	**1,836**	**1,903**	**1,975**	**2,015**	**1,970**	**2,100**	**2,193**	**2,222**	**1%**	**3%**
ANNUAL CHANGE	**6%**	**5%**	**0%**	**4%**	**4%**	**4%**	**2%**	**–2%**	**7%**	**4%**	**1%**		

Note: Data were collected from individual graduates. nr = none reported. Source: "Survey of Earned Doctorates," National Science Foundation